

Flora of Bokor National Park, Cambodia I: Thirteen New Species and One Change in Status

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Thirteen new species from Bokor National Park, Kampot Province, Cambodia are described and illustrated: *Heteropanax bokorensis* Tagane & Nagam., sp. nov., *Schefflera cambodiana* Yahara & Tagane, sp. nov., *Dichapetalum cambodianum* Tagane & Nagam., sp. nov., *Elaeocarpus bokorensis* Tagane, sp. nov., *Croton phourinii* H. Toyama & Tagane, sp. nov., *Lithocarpus eriobotryifolius* Yahara, sp. nov., *Cinnamomum bokorense* Tagane & Yahara, sp. nov., *Cinnamomum dimorphandrum* Yahara & Tagane, sp. nov., *Lindera bokorensis* Tagane & Yahara, sp. nov., *Memecylon bokorensis* Tagane, sp. nov., *Syzygium elephantinum* Tagane, sp. nov., *Phyllanthus bokorensis* Tagane, sp. nov., and *Ardisia smaragdinoidea* Yahara & Tagane, sp. nov. In addition, *Rhaphiolepis mekongensis* (Cardot) Tagane & H. Toyama, stat. nov. is recognized as a distinct species. A lectotype for *R. indica* var. *mekongensis* Cardot is also selected.

Key words: Bokor National Park, Cambodia, flora, new species, taxonomy

Bokor National Park, Kampot Province, southern Cambodia, covers 140,000 ha of tableland known as Elephant Mountains or Mt. Kamchay (Cam Chay). The tableland faces the Gulf of Thailand. The southern slope rises from sea level to the southern peak at 1,079 m (Rundel *et al.* 2003) (Fig. 1). The distance between the peak and the sea is just 6 km.

The unique topography results in the Bokor Plateau receiving more than 5,000 mm of rainfall annually. The area is one of the wettest sites in mainland Indochina (Tixier 1979). Supported by this rich rainfall, the whole mountain of Bokor is covered with wet evergreen rainforest. Three forest types have been observed along the altitudinal gradient: montane evergreen forest dominated by *Dacrydium elatum* (Roxb.) Wall. ex Hook. and

Dacrycarpus imbricatus (Blume) de Laub. (Podocarpaceae), hill evergreen forest dominated by Fagaceae with Lauraceae and Myrtaceae, and dry evergreen forest dominated by Dipterocarpaceae and *Swintonia pierrei* Hance (Anacardiaceae) (Rollet 1972, Rundel 1999). On the top of the plateau, a well-developed sphagnum bog, Popokvil bog, is dominated by four graminoid species, *Eremochloa eriopoda* C. E. Hubb. (Poaceae), *Eriocaulon* cf. *henryanum* Ruhland (Eriocaulaceae), *Dapsilanthus disjunctus* (Mast.) B. G. Briggs & L. A. S. Johnson (Restionaceae), and *Centrolepis cambodiana* Hance (Centrolepidaceae). This type of bog is relatively rare in mainland Southeast Asia (Tixier 1979, Rundel *et al.* 2003).

Floristic diversity of the Bokor mountain range was studied by French botanists during the

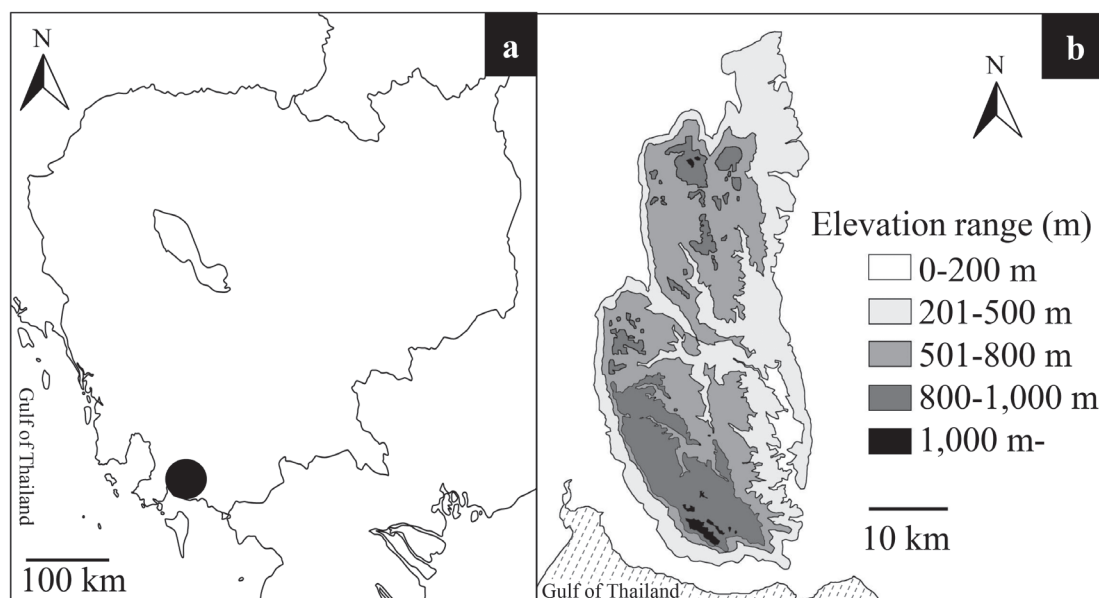


FIG. 1. Map of Bokor National Park. a, Locality of Bokor National Park in Cambodia; b, geography information on Bokor Plateau categorized by elevation range.

first half of the 20th century as part of a floristic survey of the whole Indochinese region (Lecomte 1907–1951). The floristic treatments included many species endemic to the Bokor mountain range, such as *Camchaya kampotensis* Gagnep. (Asteraceae), *Castanopsis cambodiana* A. Chev. ex Hickel & A. Camus (Fagaceae), *Cinnamomum cambodianum* Lecomte (Lauraceae), *Diospyros elephasii* Lecomte (Ebenaceae), *Globba geoffrayi* Gagnep. (Zingiberaceae), *Illicium cambodianum* Hance (Schisandraceae), *Impatiens zygosepala* Hook. f. (Balsaminaceae), *Liquidambar cambodiana* (Lecomte) Ickert-Bond & J. Wen (Altingiaceae), *Memecylon geoffrayi* Guillaumin (Melastomataceae), *Oldenlandia kamputensis* Pit. (Rubiaceae), *Ophiopogon pierrei* L. Rodr. (Asparagaceae), *Phlogacanthus geoffrayi* Benoist, *P. poilanei* Benoist (Acanthaceae), *Phyllanthus kampotensis* Beille (Phyllanthaceae) and *Ventilago sororia* Hance (Rhamnaceae). Further floristic studies were interrupted by unrest in the region until peace was restored in the 1980s. Since then, four additional vascular plants were described from this area: *Argostemma fasciculata* Sridith & K. Larsen (Rubiaceae, Sridith &

Larsen 2003), *Nepenthes bokorensis* Mey (Nepenthaceae, Mey 2009), *Syzygium bokorense* W. K. Soh & J. Parn. (Myrtaceae, Soh & Parnell 2011) and *Bulbophyllum konstantinovii* Aver. (Orchidaceae, Aberyanov 2013). It is expected that additional undescribed species will be discovered during more intensive floristic surveys.

The vegetation of the Bokor mountain range has deteriorated under the increasing pressure of logging and resort development (Kowalczyk 2009). Evaluating the plant diversity of Bokor National Park should be a high priority for conservation planning (Rundel 1999, Kosterin 2012). In response to this urgent need, we conducted surveys of the flora of the southern slope of Bokor National Park from December 2011 to December 2013. During these surveys, we collected ca. 3,100 specimens, including ca. 770 identified species of trees, shrubs, vines and palms in 108 families (2,216 specimens) and additional herbaceous species that remain mostly unidentified.

Here, as a first step in compiling a flora of Bokor National Park, we describe thirteen new species found in our survey. We also show that *Rhaphiolepis indica* (L.) Lindl. var. *mekongensis*

Cardot should be recognized as a distinct species. Our collections were determined by detailed comparisons with literature reports, with dried specimens in the herbaria BKF, BO, FU, KEP, KYO, SAR, SING and VNM, and with digital images of specimens available on the web (e.g. JSTOR Global Plants, P).

For each taxon, we used DNA barcoding to help in identifying the species based on DNA sequences in available data banks and to contribute to further phylogenetic analyses. Two DNA barcode regions, *rbcL* and *matK*, were chosen, following the recommendation of the CBOL Plant Working Group (2009). The analyses followed Toyama *et al.* (2015).

Voucher specimens were deposited in the herbarium of the Forest Administration of Cambodia (here abbreviated Cam), the Herbarium of the Museum of Kyushu University (FU), the Herbarium of Kyoto University Museum (KYO), and partly in the Forest Herbarium, Bangkok (BKF), the Royal Botanic Gardens Kew (K) and Muséum national d'Histoire naturelle (P).

Descriptions

Araliaceae

***Heteropanax bokorensis* Tagane & Nagam., sp. nov.**—Figs. 2, 3

Similar to *Heteropanax brevipedicellatus* H. L. Li of southern China and northern Vietnam in having short pedicels, but the inflorescence axis is thicker, stouter and not covered with persistent dark ferruginous indumentum.

Typus. CAMBODIA, Kampot: southern slope of Bokor National Park, edge of evergreen forest, 10°38'04"N, 104°05'19"E, alt. 741 m, 17 October, 2012, *Tagane S, Fuse K & Choeng HN 4311* (holotype—KYO; isotypes—Cam, FU, K).

Trees, 12 m tall. Young twigs ferruginous stellate pubescent, but soon glabrous, lenticellate. Leaves 3 times pinnately compound, 60–70 cm long; petiole and rachis glabrous; petiole 19–25 cm long; leaflets obovate, elliptic to broadly elliptic, (2.7–)4.5–7.5 × (1.4–)1.9–3.4 cm, both surfac-

es glabrous, upper surface lustrous, base cuneate, margin entire, apex acuminate to caudate, acumen 0.6–1(–1.3) cm long; midribs prominent on both surfaces, secondary veins 4 or 5 pairs, arising at 35–40° from midvein, prominent beneath, tertiary veins obscure on both surfaces. Inflorescence umbel-bearing racemes corymbosely arranged on terminal common axis, rachis ferruginous stellate pubescent when young, soon glabrous except around base of peduncle and pedicel; common axis more than 30 cm long; racemes 13–15, 17–30 cm long, each bearing 15–30 umbels; umbel ca. 1.8 cm in diam. at anthesis, consisting of 36–45 flowers; peduncle 0.9–1.7 cm long; basal bract short triangular to triangular, 1.2–2 mm long. Staminate flowers; pedicel ca. 4 mm long, ferruginous stellate pubescent; calyx lobes 5, short triangular, ferruginous stellate pubescent; petals 5, oblong, ca. 3 × 1.5 mm, apex acuminate, glabrous; stamens 5, anthers ca. 1.1 mm long, filaments ca. 4 mm long; style 1, ca. 1.5 mm long. Hermaphroditic flowers not seen. Fruit not seen.

Distribution. Cambodia (endemic to Bokor).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 741 m, 10°38'04"N, 104°05'19"E, 19 July 2012, *Tagane et al. 4094* [young fl.] (Cam, FU) & 8 December 2013, *Tagane et al. 6115* (BKF, Cam, FU).

GenBank accession No. *Tagane et al. 4311*: AB936049 (*rbcL*), AB936050 (*matK*).

Note. We found only two small populations of *Heteropanax bokorensis* on steep slopes in Bokor National Park, at 741 m and 890 m. It is remarkable that a flowering individual collected at alt. 741 m (type collection) had only staminate flowers, while *Heteropanax* has been described as andromonoecious (Seemann 1866; Xiang & Lowry, 2007). We observed this individual throughout the year (in Feb., May, July, Aug., Oct., and Dec. in 2012–2013) and collected specimens 4095, 4311 and 6115, but we never observed it fruiting. *Heteropanax bokorensis* may be dioecious.

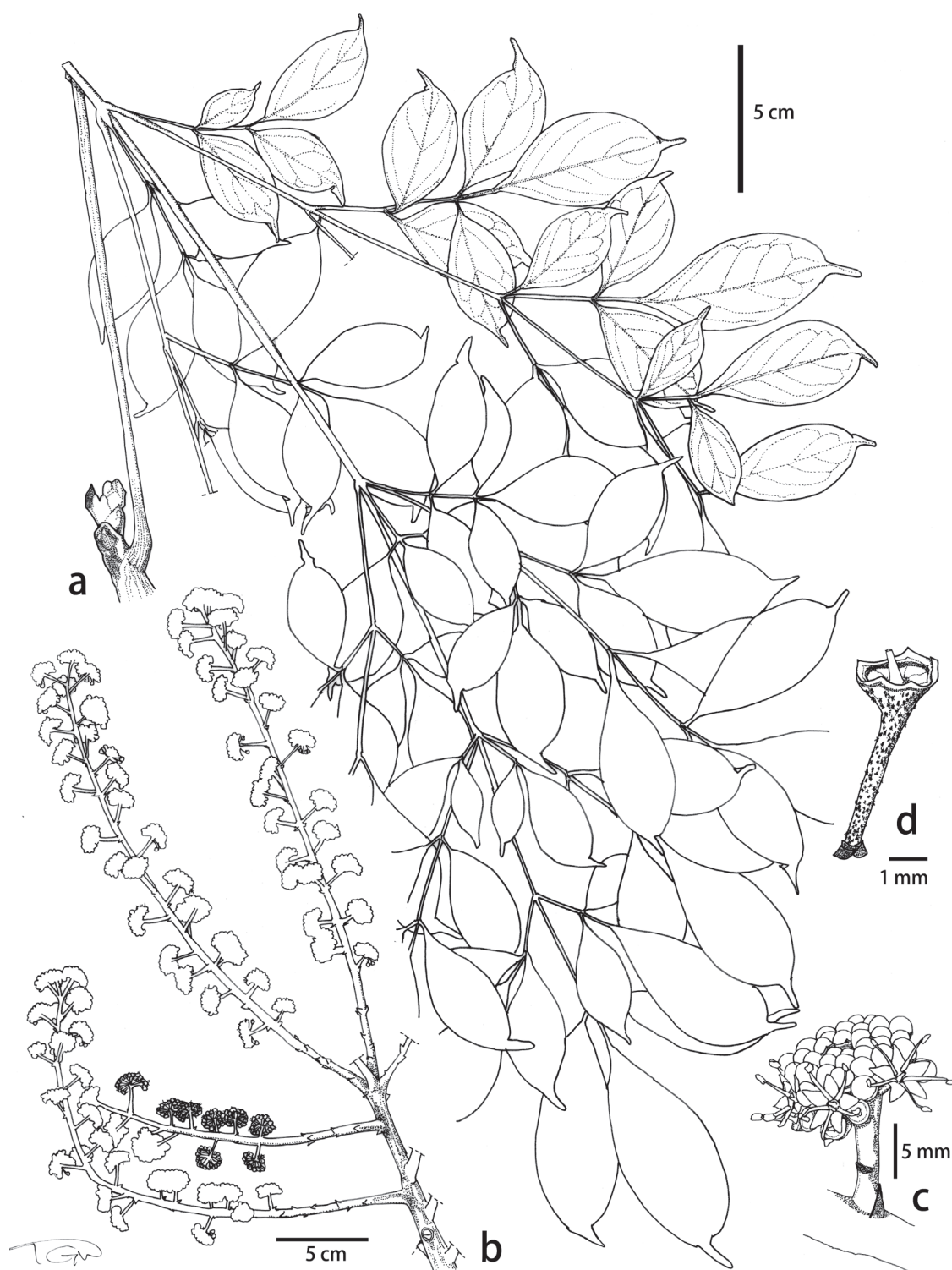


FIG. 2. *Heteropanax bokorensis* Tagane & Nagam. a, portion of branch; b, portion of inflorescence; c, flowering portion of umbel; d, staminate flower with petal removed. a–d, Tagane *et al.* 4311, KYO. Drawn by S. Tagane.



FIG. 3. *Heteropanax bokorensis* Tagane & Nagam. a, branch with inflorescence; b, branch with leaf; c, habit; d, lower surface of leaf; e, top branch; f, portion of inflorescence; g, flower.

***Schefflera cambodiana* Yahara & Tagane, sp. nov.**—Figs. 4, 5

Similar to *Schefflera hypoleuca* (Kurz) Harms in the shape of the inflorescence, but differing in the number of petals and stamens (8 in *S. cambodiana* v.s. 5 in *S. hypoleuca*). Also similar to *S. fantsipanensis* Bui in leaf morphology, but distinct from the latter in its papery texture and yellowish brown stellate tomentum on young branches.

Typus. CAMBODIA, Kampot: Bokor National Park, Popokvil waterfall, evergreen forest, 10°39' 42"N, 104°02'56"E, alt. 894 m, 11 Dec. 2013, *Tagane S, Toyama H, Fuse K, Iwanaga F, Rueangrua S, Suddee S, Kanemitsu H, Zhang M, Kim W & Loth M* 6237 (holotype—KYO; isotypes—BKF, Cam, FU, K, P).

Trees, 6 m tall; branchlets flesh colored, tomentose when young, glabrous at maturity. Leaves alternate, palmately compound; petiole 26–46 cm long; petiolules 3.2–7.4 cm long; leaflets (6–)7–10, elliptic to obovate, (9.5–)15.5–23.5 × (3.3–)6–8.4 cm, papery, upper surface glabrous, lower surface sparsely stellate tomentose, base rounded, margin subentire or serrulate, apex acuminate; secondary veins (9–)12–16 pairs, prominent on lower surface. Inflorescence a terminal panicle of umbels with a few flowers on secondary axes, stellate pubescent; primary axis 9.5–10.5 cm long, secondary axes to 5 cm long; umbels ca. 1.6 cm in diam. Flowers 13–25 per umbel; pedicel 4–5 mm long, creamy brown tomentose; calyx lobes 5, short triangular, stellate pubescent; petals 8, triangular, ca. 3.5 × 1.2 mm, apex acute, sparsely stellate pubescent near apex; stamens 8, anthers ca. 1.3 mm long, filaments 5–6 mm long, glabrous; ovary (9–)11–13-carpellate; styles united into a column, less than 1.5 mm long. Fruit not seen.

Distribution. Cambodia (endemic).

Other Specimens examined. CAMBODIA, Bokor National Park, alt. 970 m, 10°37'35" N, 104°03'57"E, 22 October 2012, *Yahara et al.* 4381 (Cam, FU); alt. 903 m, 10°39'35"N, 104°03'03"E, 13 May 2012, *Toyama et al.* 3145 (Cam, FU); alt. 888 m, 10°37'15"N, 104°05'11"E, 10 December 2011, *Toyama et al.* 1924 (Cam, FU).

GenBank accession No. *Toyama et al.* 1924: AB936030 (*rbcL*), AB936031 (*matK*); *Yahara et al.* 4381: AB936051 (*rbcL*), AB936052 (*matK*).

Note. *Schefflera cambodiana* is a tree to 6 m tall, occasional in moist evergreen forests at high elevations, especially common at along streams below Popokvil Waterfall. The closely related *Schefflera hypoleuca* is andromonoecious, having a terminal bisexual umbel and 1–4 lateral umbels of staminate flowers (Xiang & Lowry, 2007). In *S. cambodiana*, however, we found only bisexual flowers, probably because other flowers were not matured. *Schefflera* is widely distributed in the tropics and subtropics worldwide and is known to be polyphyletic (Plunkett *et al.* 2004). Phylogenetic analyses based on nuclear and plastid DNA sequence data strongly support the monophyly of Asian *Schefflera*, which are sister to *Heteropanax* and *Tetrapanax* (Li & Wen, 2014). The common characteristics of the Asian *Schefflera* group, such as the woody habit, lack of prickles, palmately compound leaves, paniculate inflorescence, absence of articulations on the pedicels and the gynoeceum with styles united into a column, also occur in *S. cambodiana*.

Dichapetalaceae

***Dichapetalum cambodianum* Tagane & Nagam., sp. nov.**—Figs. 6, 7

Similar to *Dichapetalum longipetalum* (Turcz.) Engl. (Synonym, *D. baillonii* Pierre), but differing in having smaller leaves, which are less pubescent abaxially (10–15 × 4–5.6 cm, densely velutinous abaxially in *D. longipetalum*) and shorter style, to ca. 1.8 mm long (ca. 4 mm long in *D. longipetalum*). Also similar to *D. gelonioides* (Roxb.) Engl. var. *pilosum* Leenh. in having glabrous, elliptic leaves less than 10 cm long, greenish when dry, and drupes with a single pyrene, but distinct in size and shape of the drupe (globular and 1–1.5 cm long in *D. gelonioides*).

Typus. CAMBODIA, Kampot: Bokor National Park, southern slope of Mt. Bokor, evergreen forest, 10°37'54"N, 104°05'26"E, alt. 763 m, 16 February 2013, *Tagane S, Toyama H, Wachi N, Ichihashi R, Mase K, Zhu M, Chhang P* 5506 (holotype—KYO, isotypes—BKF, Cam, FU, K, P).

Lianas, climbing to 20 m long. Young branchlets pubescent, old branches subglabrous to glabrous, grayish brown, with many rounded lenticels. Stipules linear, ca. 2–5 mm long, pilose, de-

ciduous. Petioles 2.5–3 mm long, pilose when young. Leaf blade papery, elliptic, 5.7–9.5 × 2–3.7 cm, base cuneate, margin entire, apex abruptly acuminate, acumen to 1.1 cm long; midvein prominent on both surfaces; secondary veins 6 or 7 pairs, curved, looped and joined to upper veins near margin, prominent on both surfaces; tertiary veins finely reticulate, whitish and prominent on lower surface, slightly prominent on upper surface; both surfaces glabrous except midvein and secondary veins with sparse hairs. Cymes axillary, sessile, pubescent, 0.5–1 cm long, many flowered; bracteoles linear, to 1.4 mm long. Flowers pedicellate; pedicels 1–2 mm long at anthesis, ca. 3 mm long in fruit; sepals imbricate, elliptic-oblong, unequal, 2.5–3 × 1.5–2 mm, whitish green, villous outside, glabrous inside; petals dark purple, oblanceolate, 2.5–3 mm long, glabrous, shallowly bilobed, lobes 0.5–1 mm long; glands opposite petals, transversely oblong, sometimes shallowly bilobed, pubescent, 0.25–0.5 mm long; stamens 5, 3–3.5 mm long, glabrous, anthers ca. 0.6 mm long; ovary of perfect flowers conical or ovoid, densely yellowish brown pubescent, ca. 3 mm long, 3-locular; style 1, glabrous, 3-lobed; abortive ovary of staminate flowers white lanate, ca. 1.2 mm long; style 1, glabrescent, ca. 1.8 mm long, 3-lobed. Fruiting July to October; drupe broadly ellipsoid, flattened, 2.3–2.5 cm long, 1.1–1.6 cm wide, 0.6–0.9 cm thick, apex acute, villous with dense fulvous hair, with distinct sutures on margin, 1-seeded; seeds ovoid, 1.2 cm long, 0.6 cm wide.

Distribution. Cambodia. Also in Thailand? (see note).

Other specimens examined. CAMBODIA, Bokor National Park, evergreen forest on the southern slope: alt. 903 m, 10°39'35"N, 104°03'03"E, 13 May 2012, *Toyama et al.* 3105 (Cam, FU); alt. 888 m, 10°37'15"N, 104°05'11"E, 9 December 2011, *Toyama et al.* 1875 & 1903 (Cam, FU); alt. 760 m, 10°38' 03"N, 104°05' 18"E, 24 October 2012, *Yahara et al.* 4530 [fr.] (Cam, FU); alt. 741 m, 10°38'04"N, 104°05'19"E, 19 July 2012, *Tagane et al.* 4093 [fr.] (Cam, FU); 8 December 2013, *Tagane et al.* 6114 (BKF, Cam, FU), alt. 721 m, 10°37'40"N, 104°05'35"E, 12 December 2011, *Toyama et al.* 2105 (Cam, FU). —Kampong Speu Province, Pnom Tho ma so Pres village Ko Virk: alt. 600–700 m, 3 May 1928, *Poilane* 15196 (P); alt. 800–1000 m,

5 May 1928, *Poilane* 15229 (P).

GenBank accession No. *Toyama et al.* 1875: AB936024 (*rbcL*), AB936025 (*matK*); *Toyama et al.* 1903: AB936026 (*rbcL*), AB936027 (*matK*); *Toyama et al.* 2105: AB936037 (*rbcL*), AB936038 (*matK*).

Note. *Dichapetalum cambodianum* is somewhat common in evergreen forest at middle to high elevations but not on the plateau of Mt. Bokor. Pellegrin (1948) identified two specimens of *D. cambodianum* (*Poilane* 15196 & 15229, P) as *D. tonkinense* Engl., but those two specimens and ours are distinct from *D. tonkinense* in having larger fruit (2.3–2.5 cm long, 1.1–1.6 cm wide in *D. cambodianum* v.s. 1–1.2 cm long, 0.8–1.2 cm wide in *D. tonkinense*; Pellegrin 1911) and more prominent and distinct tertiary veins on the lower surface of the lamina. Leenhouts (1957) and Chen & Prance (2008) regarded *D. tonkinense* as a synonym of *D. longipetalum*. One sterile specimen from Thailand (*Niyomdham et al.*, 336, Kao Po Ta Luang Kaew, Ranong, Thailand, alt. 250–400 m, BKF) is similar to *D. cambodianum* in leaf size, shape and venation, but fertile materials are needed to confirm the identity of this collection.

Elaeocarpaceae

Elaeocarpus bokorensis Tagane, **sp. nov.** — Figs. 8, 9

Similar to *Elaeocarpus hygrophilus* Kurz (Synonym, *E. madopetalus* Pierre), but differing in fewer serrations of the lamina, inconspicuous tertiary veins, ciliate lateral margins of the petals and more stamens (38–40 in *E. bokorensis* vs. 15–25 in *E. hygrophilus*).

Typus. CAMBODIA, Kampot: Mt. Bokor, edge of dense evergreen forest, along roadside, 10°37'32"N, 104°05'16"E, alt. 844 m, 17 Oct. 2012, *Tagane S, Fuse K & Choeng HN 4300* (holotype—KYO; isotypes—Cam, K, P).

Trees, evergreen, 8–15 m tall; branchlets tomentose when young, soon glabrescent, reddish brown or blackish brown. Stipules ca. 0.5 mm long, caducous. Petioles 0.9–1.5 cm long, swollen at both ends, nearly glabrous. Leaf blade obovate to obovate-lanceolate, tapered toward base from

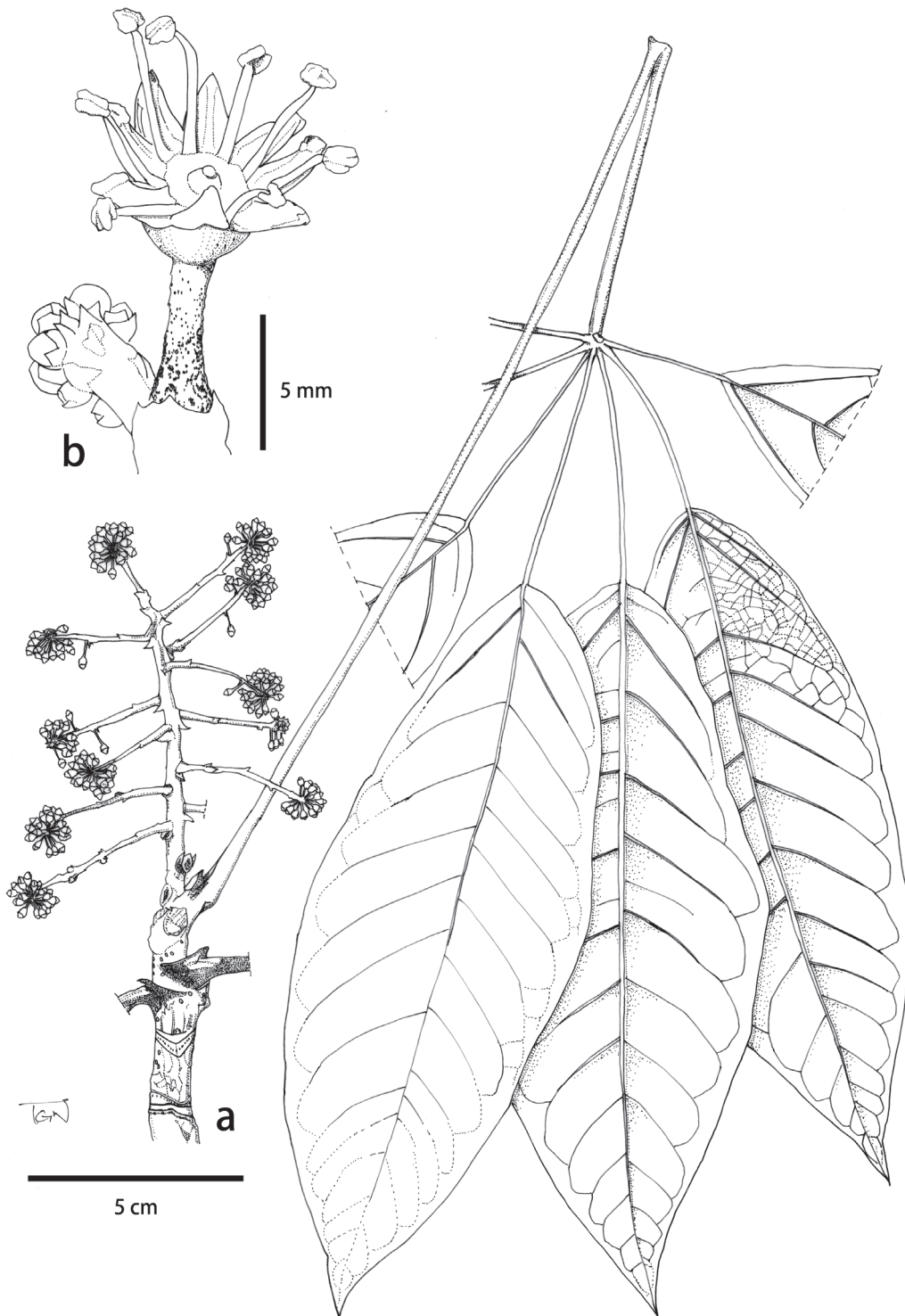


FIG. 4. *Schefflera cambodiana* Tagane. a, portion of flowering branch; b, flower. a & b, Tagane *et al.* 6237, KYO.
Drawn by S. Tagane.

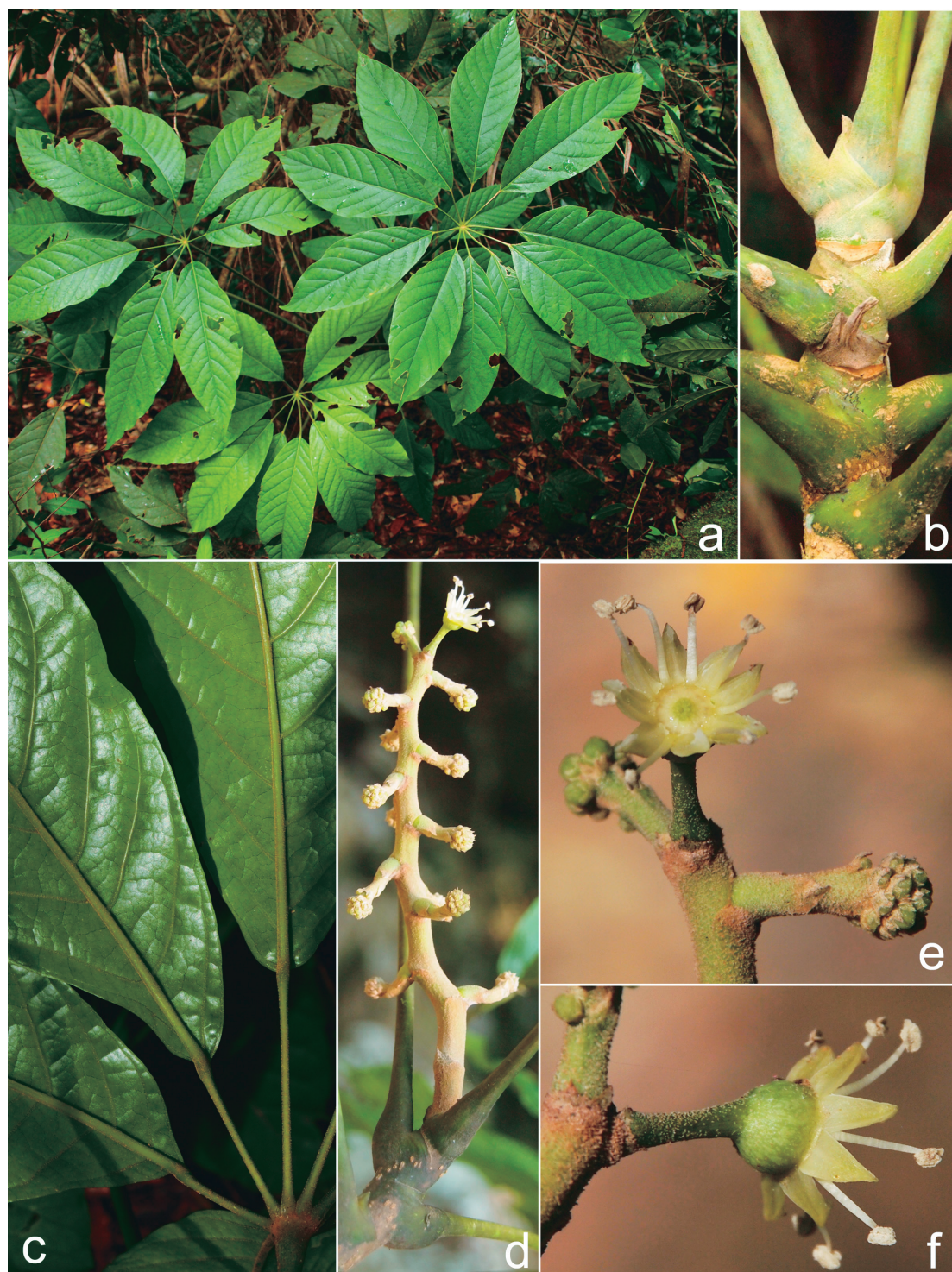


FIG. 5. *Schefflera cambodiana* Tagane. a, branch with leaves; b, top branch; c, lower surface of leaf; d, inflorescence; e-f, flowers.

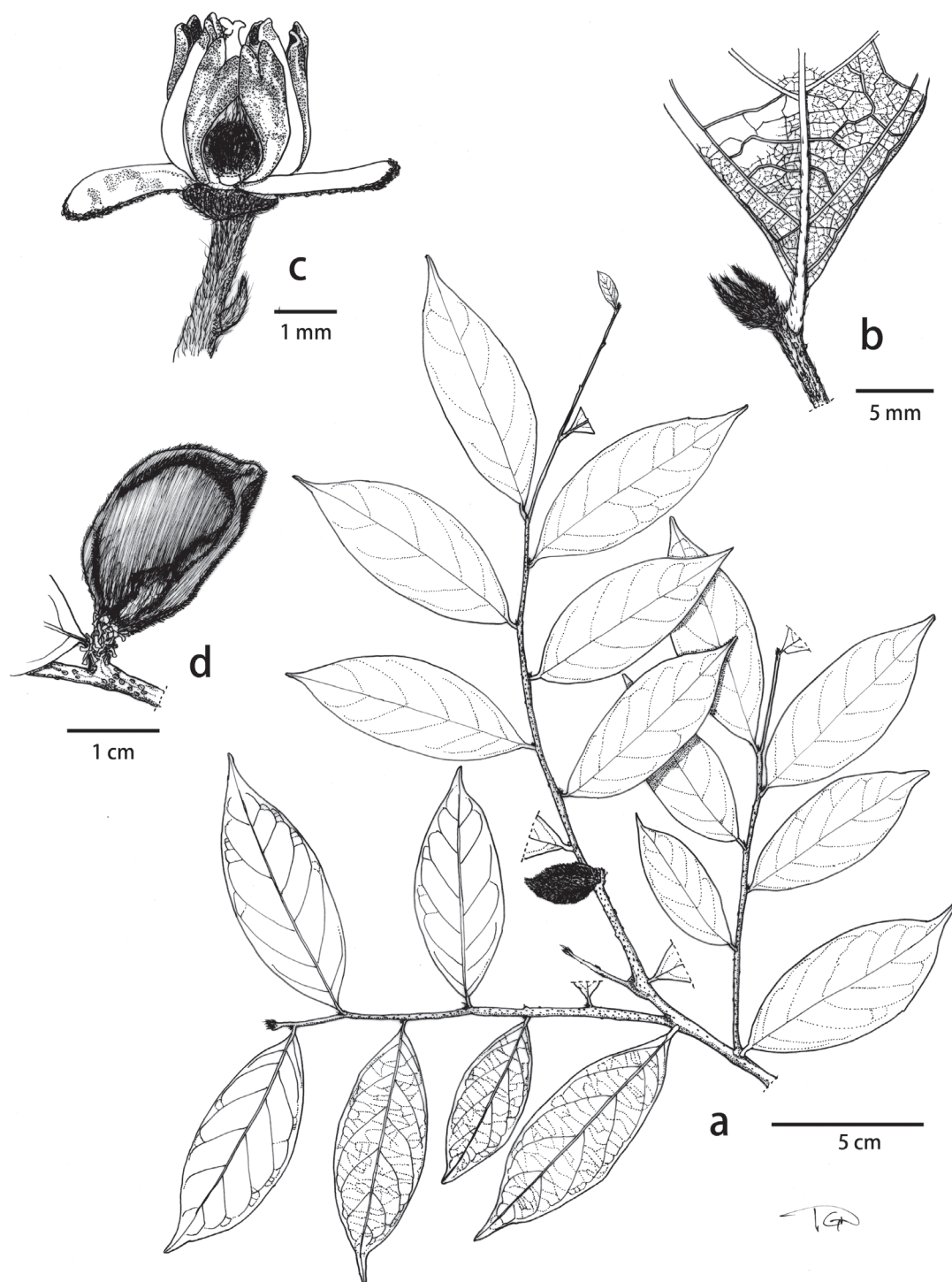


FIG. 6. *Dichapetalum cambodianum* Tagane & Nagam. a. fruiting branch; b, lower surface of leaf; c, staminate flower with one stamen removed; d, fruit. a–c, Tagane *et al.* 5506, KYO. Drawn by S. Tagane.

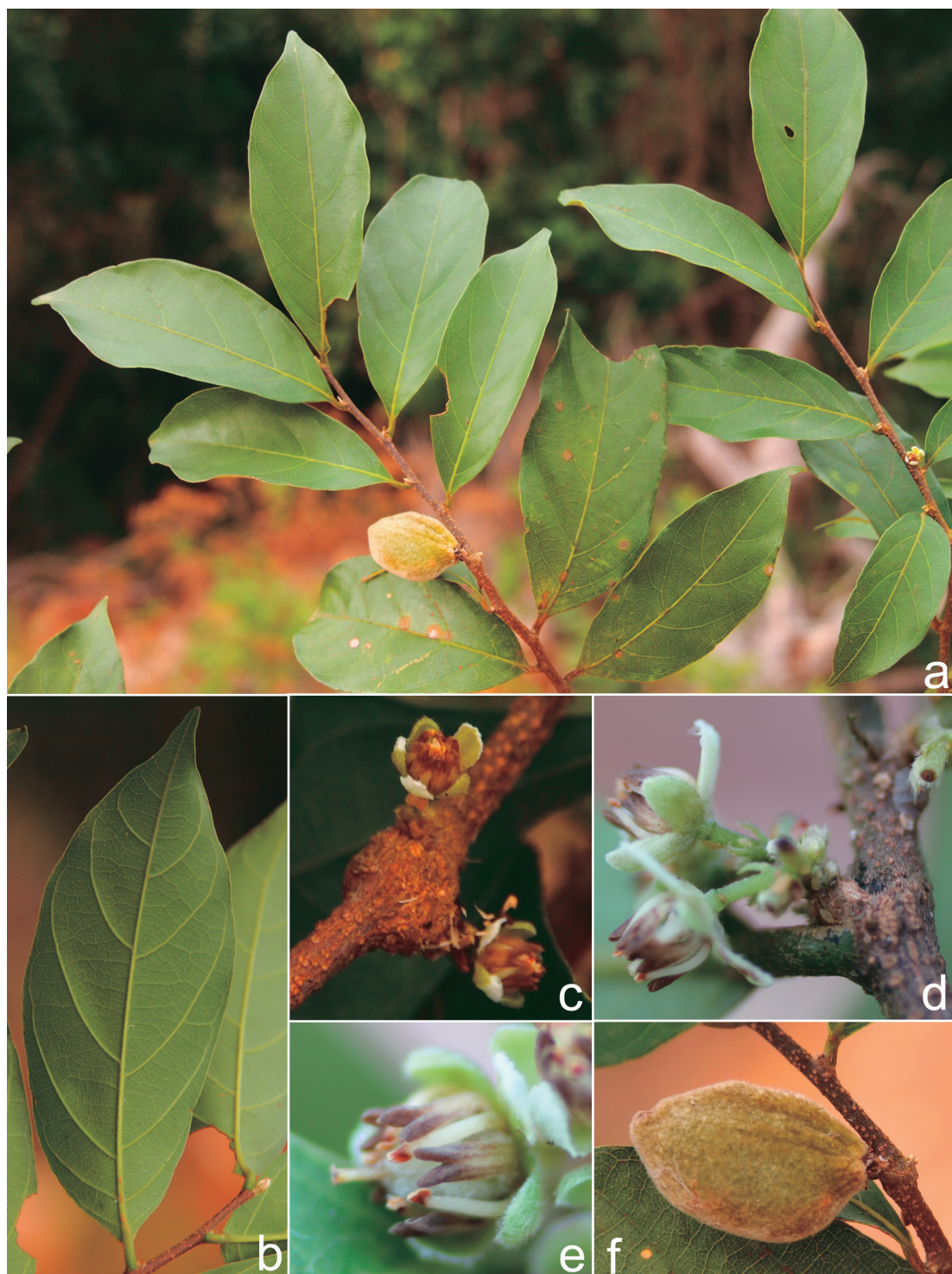


FIG. 7. *Dichapetalum cambodianum* Tagane & Nagam. a, fruiting branch; b, lower surface of leaf; c–e, staminate flowers; f, fruit.

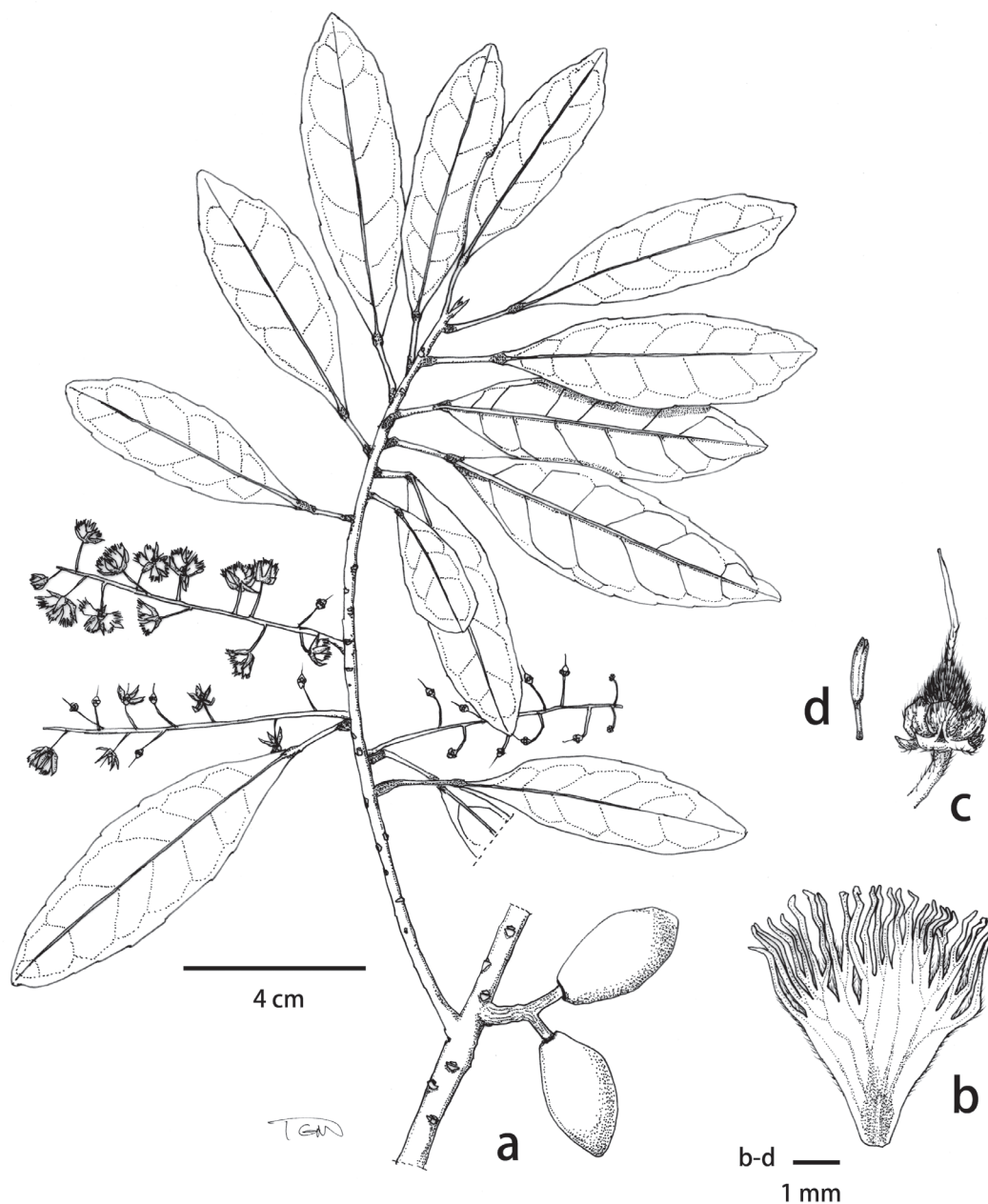


FIG. 8. *Elaeocarpus bokorensis* Tagane. a, flowering and fruiting branch; b, petal; c, flower with petals and anthers removed; d, anther. a-d, Tagane *et al.* 4300, KYO. Drawn by S. Tagane.

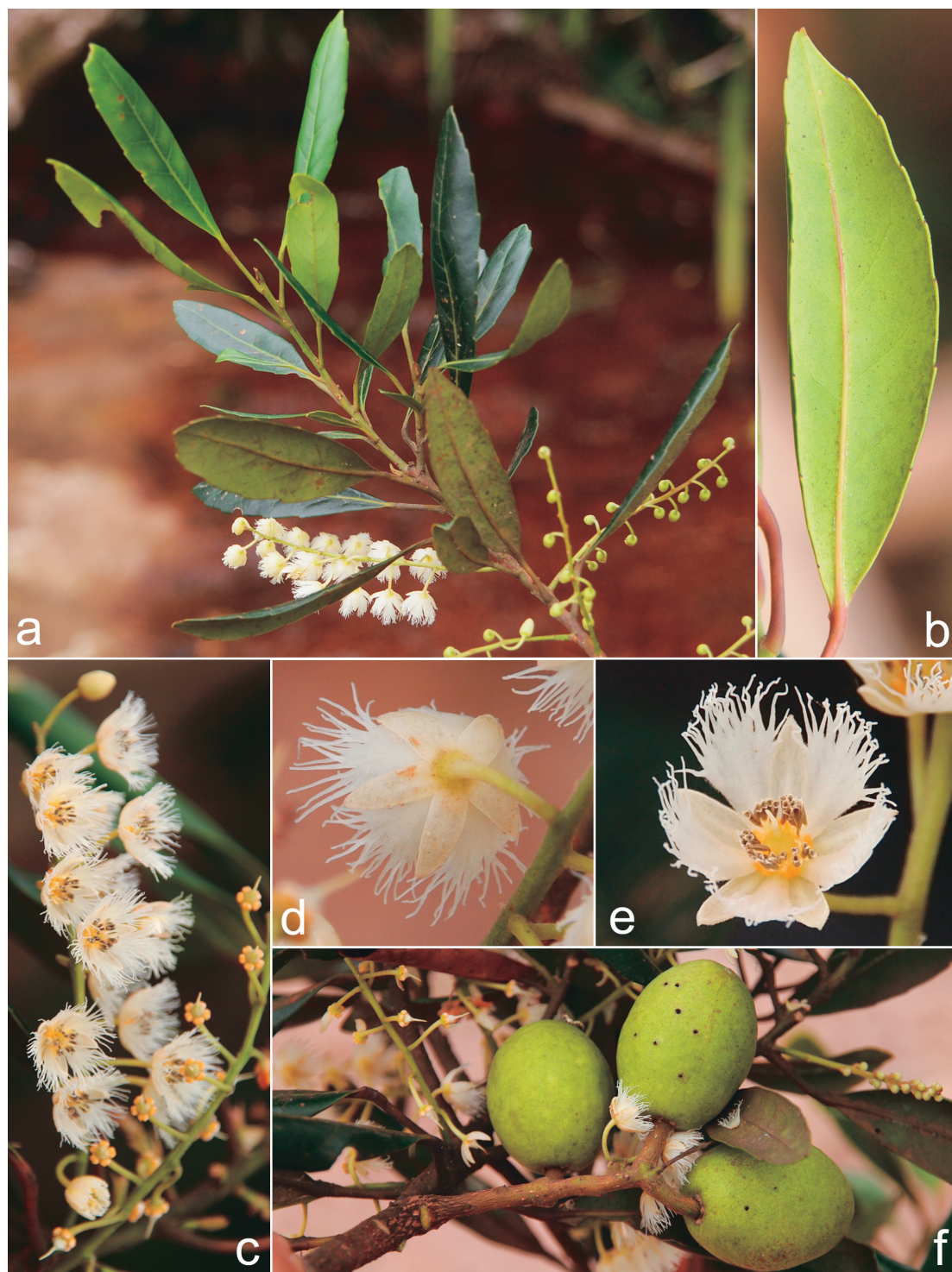


FIG. 9. *Elaeocarpus bokorensis* Tagane. a, flowering branch; b, lower surface of leaf; c, inflorescence; d–e, flower; f, fruit.

middle, $4.2\text{--}7.6 \times 1.2\text{--}2.6$ cm, coriaceous, both surfaces glabrous, base cuneate or obtuse, margin shallowly crenate with 3–6 teeth on each side, often revolute, apex obtuse to acute; secondary veins 5–7 pairs, arching and anastomosing, slightly impressed on upper surface, prominent on lower surface, tertiary veins inconspicuous on both surfaces. Inflorescences racemes, in axils of leaves on old branches, 5.8–6.3 cm long, 9–18 flowers per raceme; peduncle pubescent. Pedicels ca. 7 mm long, pubescent. Flowers ca. 1.1 cm in diam., bisexual; sepals 5, ca. 4 mm long, grayish white pubescent abaxially, glabrous adaxially except at base of midrib; petals 5, obovate, ca. 5×3 mm, glabrous except lateral margins ciliate, lacinate in upper 1/3; segments 18–24; stamens 38–40, fascicled; anthers ca. 1.3 mm long, pubescent; filament 1–1.2 mm long; disc 5-lobed; style ca. 2.5 mm long; ovary pubescent with silvery white hairs. Drupe ellipsoid, $2.8\text{--}3 \times 1.6\text{--}1.8$ cm, black when dry, glabrous.

Distribution. Cambodia (endemic).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 1043 m, $10^{\circ}37'17''\text{N}$, $104^{\circ}01'52''\text{E}$, 10 December 2013, Toyama *et al.* 6250 (BKF, Cam, FU); alt. 1014 m, $10^{\circ}38'12.59''\text{N}$, $104^{\circ}02'06.37''\text{E}$, 4 December 2011, Toyama *et al.* 1484, 1508 (Cam, FU), alt. 975 m, $10^{\circ}37'16''\text{N}$, $104^{\circ}02'23''\text{E}$, 21 December 2011, Toyama *et al.* 2484 [fl. & fr.] (Cam, FU); alt. 928 m, $10^{\circ}39'20''\text{N}$, $104^{\circ}3'37''\text{E}$, 9 May 2012, Toyama *et al.* 2795 (Cam, FU); alt. 903 m, $10^{\circ}39'34''\text{N}$, $104^{\circ}03'05''\text{E}$, 14 May 2012, Toyama *et al.* 3198 (Cam, FU); alt. 850–910 m, $10^{\circ}39'31''\text{N}$, $104^{\circ}03'05''\text{E}$, 8 December 2011, Toyama *et al.* 1761 (Cam, FU); alt. 850 m, $10^{\circ}37'32''\text{N}$, $104^{\circ}05'15''\text{E}$, 12 August 2013, Tagane & Chhang 5904 [fl.] (Cam, FU), 12 December 2013, Tagane *et al.* 6377 [fl.] (BKF, Cam, FU); alt. 1050 m, Dy Phon 1140 (P).

GenBank accession No. Toyama *et al.* 1484: AB936008 (*rbcL*), AB936009 (*matK*); Toyama *et al.* 2795: AB936046 (*rbcL*), AB936047 (*matK*).

Note. *Elaeocarpus bokorensis* is common on the plateau of Mt. Bokor from 800–1,000 m.

Euphorbiaceae

Croton phourinii H. Toyama & Tagane, **sp. nov.** —Figs. 10, 11

Similar to *Croton lachnocarpus* Benth., but differing in stature (0.5–1.5 m tall in *C. phourinii* vs. 3 m in *C. lachnocarpus*), larger leaves (11–23.5 cm long vs. to 11 cm), longer petioles (1–6.5 cm long vs. to 2.7 cm), doubly serrate leaf margins (simply serrate in *C. lachnocarpus*), glands with an apical disc (without in *C. lachnocarpus*), more flowers per inflorescence (15–32 vs. ca. 15), more stamens per flower (16–18 vs. ca. 10), and 4-fid stigma (2-fid in *C. lachnocarpus*).

Types. CAMBODIA, Kampot: Bokor National Park, forest margin along the trail on the table land, $10^{\circ}39'21''\text{N}$, $104^{\circ}03'35''\text{E}$, alt. 930 m, 22 December 2011, Toyama H, Tagane S & Chhang P 2528 (holotype–KYO; isotypes–Cam).

Shrubs, 0.5–1.5 m tall; bark pale creamy brown or dark yellowish green; young branchlets densely hispid, gradually glabrescent. Indumentum yellowish brown or hyaline, stellate–multiradiate, 8–10 free radii with a central porrect radius, 1–1.5 mm in diam. on branches, 0.25–0.5 mm in diam. on leaves. Stipules lanceolate, 2–3 mm long, hispid. Leaves alternate, usually crowded near shoot apex; petiole (0.3–)1–6.5 cm long, hispid; leaf blade oblanceolate to oblong, $(3.3\text{--})11\text{--}23.5 \times (1.1\text{--})3.5\text{--}10$ cm, membranous, slightly paler abaxially, base rounded to cordate, margin simply or doubly serrate, apex acute to acuminate, hispid on both surfaces but more densely so abaxially, especially along midrib, never becoming glabrous; basal glands distinctly stalked (stalk 0.5–0.8 mm long), with an apical disc 0.5–1 mm in diam., lateral at base of abaxial midrib, additional glands in sinus of marginal teeth of blade, 13–32 on each side, similar to basal glands in shape but smaller; secondary veins 7–11 pairs, prominent on both surfaces, tertiary veins visible on both surfaces, but more prominent on lower surface. Inflorescences simple, spike-like racemes, terminal or subterminal, 7–27 cm long, with 15–32 flowers, rachis densely hispid; bracts triangular, 2–3 mm long, densely stellate hispid, eglandular, persistent. Staminate flowers densely hispid; pedicel ca. 2 mm long; sepals ovate-lanceolate, $2.5\text{--}3 \times 1.5\text{--}2$ mm, petals oblong, $2.5\text{--}2.8 \times 2\text{--}2.5$ mm, apex rounded-obtuse; stamens 16–18, anthers ca. 0.8×0.4 mm, filaments 1.5–2.2 mm long. Pistillate flowers densely hispid.

pid; pedicel 1–2 mm long; sepals ovate-lanceolate, 4.5–5 × 2.5–2.8 mm, longer than ovary; petals absent; ovary globose, ca. 2 mm long, densely hispid; stigmas 3, free, 6–7 mm long, deeply twice bifid (4-fid), primary divisions ca. 6/7 of total length, secondary divisions ca. 5/7, adaxial surface glabrous, hispid abaxially. Capsule ca. 10 mm long, pale green to green, densely hispid. Seeds flattened, 6–7 × ca. 5.5 mm, 3.5 mm thick, with a small caruncle.

Distribution. Cambodia (endemic to Mt. Bokor).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 930 m, 10°39'34"N, 104°03'05"E, 14 May 2012, *Toyama et al.* 3197 [fl. & fr.] (Cam, FU); 10°39'20"N, 104°03'37"E, 17 July 2012, *Tagane et al.* 4014 [fl.] (Cam, FU); 10°35'34"N, 103°58'47"E, 17 February 2013, *Tagane et al.* 5769 [fl.] (Cam, FU); 10°39'09"N, 104°03'39"E, 12 December 2013, *Fuse et al.* 6350 [fl.] (BKF, Cam, FU); alt. 917 m, 10°39'31"N, 104°03'05"E, 25 October, 2012, *Toyama et al.* 4586 [fr.] (Cam, FU).

GenBank accession No. *Toyama et al.* 2528: AB936042 (*rbcL*), AB936043 (*matK*).

Note. *Croton phourinii* is locally common in moist evergreen forest on the plateau. The *matK* sequences of *Croton phourinii* (AB936043) and the closely related species *C. lachnocarpus* (HQ415239) differ in 9 of 782 total bases.

Fagaceae

***Lithocarpus eriobotryifolius* Yahara, sp. nov.** —Figs. 12, 13.

Similar to *Lithocarpus recurvatus* Barnett, but distinguished by the cupules with scales often fused with each other and never developed into pseudo spines, and the densely hairy young shoots and leaves.

Types. CAMBODIA, Kampot: Southern slope of Bokor National Park, 10°37'32"N, 104°05'15"E, alt. 850 m, 12 August 2013, *Tagane S. & Chhang P.* 5905 (holotype—KYO; isotypes—Cam, K, P).

Tree, 17 m tall, 87 cm in girth (measured from *Yahara et al.* 4411). Young shoots densely gray or brown tomentose, dark brown when dry. Stipules lanceolate, ca. 0.5 mm long, tomentose. Petioles

0.5–0.7 cm long, tomentose. Leaf blade oblanceolate-oblong, 11.5–15.5 × 4.5–5.5 cm, coriaceous, base cuneate, margin entire, apex acute, lower surface tomentose along veins, midrib and lateral veins prominently raised, tertiary veins distinct, scalariform; upper surface glabrous except raised midrib, with clearly sunken lateral veins; lateral veins 8–11 pairs. Inflorescences unknown. Inflorescence spiciform, solitary, 6.5–9.5 cm long. Acorns clustered, sessile, globose when young, hemispherical at maturity. Cupules often fused with neighboring ones, 0.5–0.6 cm tall, 1.4–1.5 cm in diam.; cupule in young fruit completely enclosing nut except the umbo, enclosing ca. 1/2 of nut at maturity; wall comprising alternate scales. Nuts hemispherical, 1.1–1.2 cm long, 1.4–1.6 cm in diam.

Distribution. Cambodia (endemic).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 930 m, 10°37'35"N, 104°03'57"E, 22 October 2012, *Yahara et al.* 4411 [fr.] (Cam, FU); 8 August 2013, *Tagane et al.* 5761 [young fr.] (Cam, FU).

GenBank accession No. *Tagane S. & Chhang P.* 5905: AB936055 (*rbcL*), AB936056 (*matK*).

Note. *Lithocarpus eriobotryifolius* is occasional on the plateau of Bokor National Park. *Lithocarpus eriobotryifolius* is similar to *L. recurvatus* Barnett of northeastern Thailand (Phu Kradung and Phu Luang) in that the nut is first enclosed completely by the cupule, then its upper half exposed at maturity. They are distinguishable as shown in the diagnosis. *Lithocarpus eriobotryifolius* is also distinct in the densely hairy young shoots and leaves, as in *L. garrettianus* (Craib) A. Camus, but the cupules of the latter are covered with recurved pseudo-spines.

Lauraceae

***Cinnamomum bokorensense* Tagane & Yahara, sp. nov.** —Figs. 14, 15

Cinnamomum elephantinum Kosterm., *in sched.*

Similar to *Cinnamomum cinereum* Gamble of the Malay Peninsula in the shape and venation of the leaves, but distinct in having much thicker leaves and shorter secondary

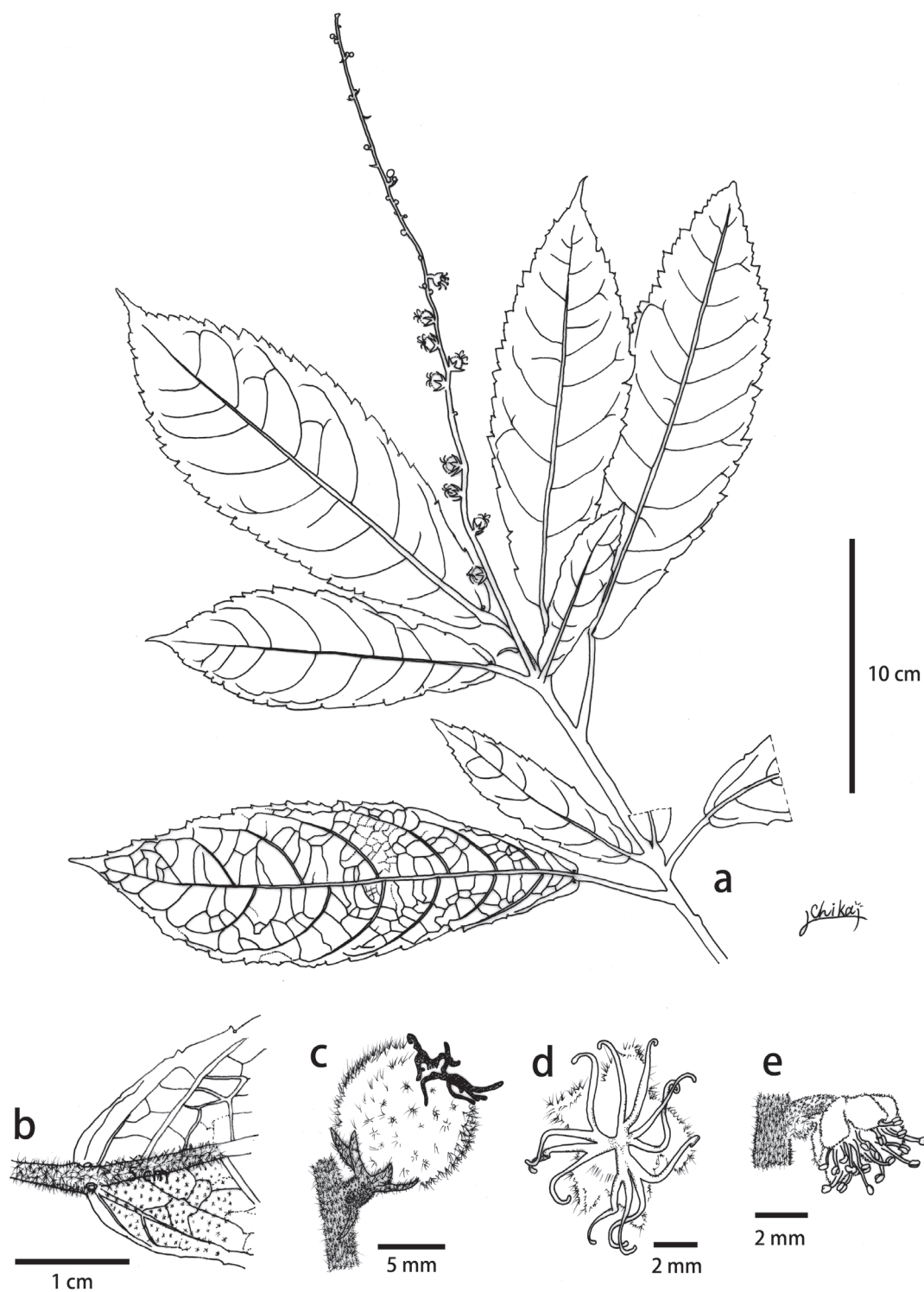


FIG. 10. *Croton phourinii* H. Toyama & Tagane. a, flowering branch; b, lower surface of leaf base showing basal glands; c, fruit; d, pistil flower; e, staminate flower. a–e, *Toyama et al.* 3197, KYO. Drawn by C. Mitsuyuki.

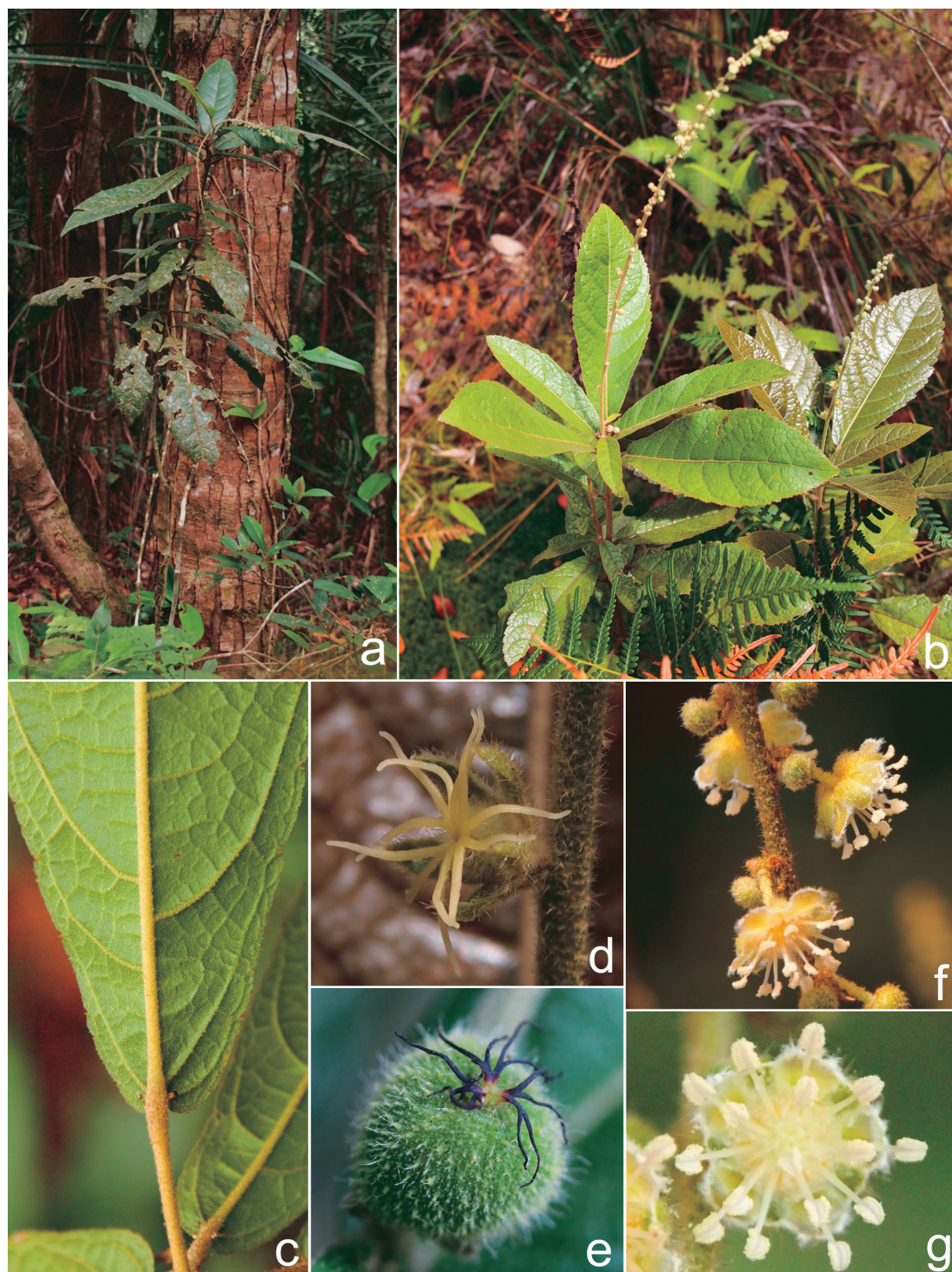


FIG. 11. *Croton phourinii* H. Toyama & Tagane. a, habit; b, flowering branch; c, lower surface of leaf; d, pistillate flower; e, fruit; f–g, staminate flower.

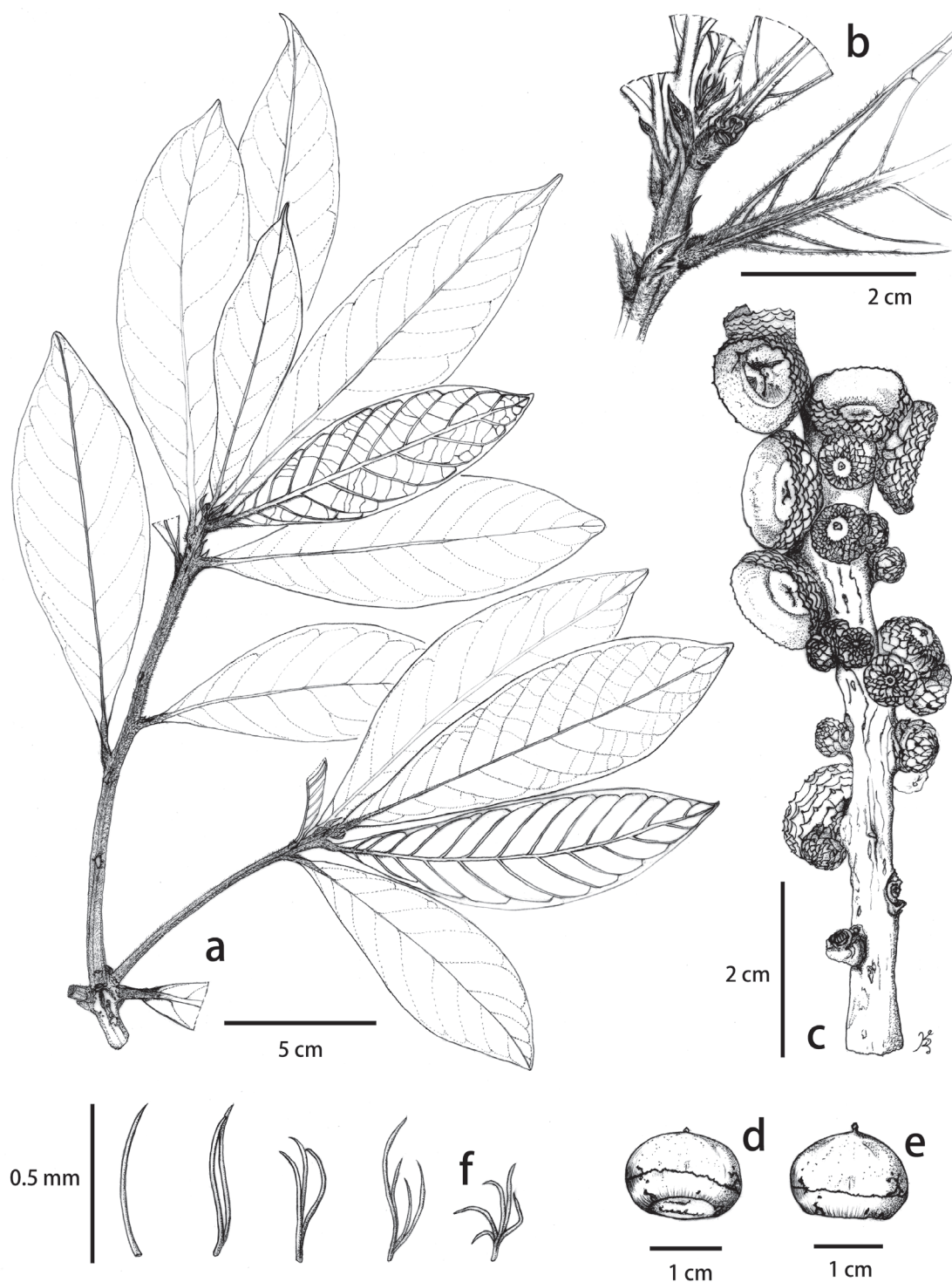


FIG. 12. *Lithocarpus eriobotryifolius* Yahara. a, branch; b, top branch with lower surface of leaf; c, infructescence; d-e, acorn; f, variation of stellate hairs. a-b, Yahara *et al.* 4411, KYO; c-f, Tagane & Chhang 5905, KYO. Drawn by K. Mase.



FIG. 13. *Lithocarpus eriobotryifolius* Yahara. a, branch; b, lower surface of leaf; c, top branch with stipule; d–e, infructescence; f, backside of acorn.

axis of the inflorescences.

Types. CAMBODIA, Kampot: Mt. Bokor, forest margin, 10°36'19"N, 104°06'03"E, alt. 529 m, 15 July 2012, *Tagane S., Fuse K. & Chhang P. 3941* (holotype–KYO; isotypes–Cam, FU).

Trees, 5–22 m tall. Branchlets terete, glabrous. Leaves subopposite; petiole 1.1–1.8 cm long, glabrous; leaf blade glabrous, ovate to narrowly ovate, 11–16.1 × 4.2–7.3 cm, rigidly leathery, lustrous on upper surface, base broadly cuneate to subrounded, margin involute, entire, apex obtuse, acute or acuminate; trinerved or triplinerved, midrib and lateral veins elevated on lower surface, slightly impressed on upper surface, lateral veins 7–11(–13) pairs, basal lateral veins arising 0.8–1.5 cm above leaf base, extending to half length of blade, veins in upper half of leaves pinnate. Inflorescences terminal or axillary panicles, often branched at base; branches elongate, 11–16 cm long, branches and rachis 4-angled, glabrous. Pedicels to 8 mm long, sparsely sericeous–villous. Perianth tube obconical, ca. 6 mm long; lobes 6, ovate, ca. 3 × 1.5 mm, apex obtuse, densely puberulent on both surfaces. Fertile stamens 9, ca. 2.2 mm long in 1st and 2nd whorls, ca. 2.8 mm long in 3rd whorl; filaments villous, with 2 subsessile reniform glands slightly below middle in 3rd whorl; anthers oblong, ca. 1.1 mm long in 1st and 2nd whorls, ca. 0.9 mm in 3rd whorl, all anthers 4-celled; cells of 1st and 2nd whorls introrse, those of 3rd whorl extrorse. Staminodes 3, ca. 1.5 mm long, short stalked, stalk villous. Ovary ellipsoid, ca. 3 × 1.5 mm, glabrous; style ca. 2 mm long, stigma inconspicuous. Fruit unknown.

Distribution. Cambodia, Thailand (SE).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 935 m, 10°39'09"N, 104°03"E, 10 May 2012, *Toyama et al. 2844* (Cam, FU); alt. 721 m, 10°37'41"N, 104°05'37"E, 11 December 2011, *Toyama et al. 1995* (Cam, FU); alt. 602 m, 10°36'45"N, 104°06'01"E, 8 December 2013, *Toyama et al. 6058* (BKF, Cam, FU); alt. 444 m, 10°36'24"N, 104°05'36"E, 11 May 2012, *Toyama et al. 2979* (Cam, FU); alt. 370 m, 10°36'34"N, 104°04'13"E, 10 August 2013, *Tagane et al. 5849* (Cam, FU); in montibus Cam Chay Prov.: Kampot: May 1874, *Pierre 159* (P); region de Kampot, Kamchay et montagne de l'elephant, 14–17, December, 1918, *Chevalier 35988*

(P). —Phnom Penh: Foret de Phnom Penh, 16 February 1935, *Beaud 742* (P). —Pursat: in montibus Knang Re-poeu, prov. Thepong, May 1870, *Pierre 664* (P); Foret libre, Khum Trapong, 17 June 1924, *s.n. 1* (P); phnom Hel-hirn, *Muller 530* (P). THAILAND. Chanthaburi: evergreen forest near 16th waterfall, Khao Soi Dao Wildlife Sanctuary, Chanthaburi, Thailand, alt. 600 m, 18 May, 2013, *Tagane et al. T1694* (BKF, FU).

GenBank accession No. *Toyama et al. 1995*: AB936033 (*rbcL*), AB936034 (*matK*); *Toyama et al. 2979*, AB936048 (*rbcL*).

Note. *Cinnamomum bokorensense* is scattered in evergreen forests at mid elevations on Mt. Bokor. Kostermans wrote '*Cinnamomum elephantinum*' on specimens in the Muséum national d'Histoire naturelle (P) cited above, but the name is unpublished.

***Cinnamomum dimorphandrum* Yahara & Tagane, sp. nov.** —Figs. 16, 18a–c

Cinnamomum myrtifolium Kosterm., *in sched.*

Similar to *Cinnamomum tetragonum* Chev. of Vietnam, but distinguished by having thicker leaves with inconspicuous tertiary veins and a larger, bowl shaped perianth cup covering 1/3 of the fruit (flat perianth cup covering less than 1/5 of fruit in *C. tetragonum*).

Types. CAMBODIA, Kampot: Bokor National Park, Popokvil waterfall, edge of evergreen forest along stream, 10°39'42"N, 104°02'56"E, alt. 894 m, 11 December 2013, *Fuse K, Tagane S, Toyama H, Iwanaga F, Rueangruea S, Suddee S, Kanemitsu H, Zhang M, Kim W, Loth M 6229* (holotype–KYO; isotypes–BKF, Cam, FU, K).

Trees. Young branchlets 4-angled, glabrous, yellowish green, dark brown when dry. Leaves subopposite; petiole 0.6–1.2 cm long, glabrous; leaf blade faintly lustrous on upper surface, leathery, glabrous, elliptic to ovate, often narrowly ovate, 4.6–8.3(–10.1) × 1.6–3.2(–3.5) cm, base broadly cuneate to rounded, margin entire, apex acute, acuminate or caudate; trinerved with basal lateral veins oblique, extending to near apex, transverse veins inconspicuous. Inflorescences terminal and axillary 2–4-flowered corymbs, peduncle 3.5–7.5 cm long, glabrous. Pedicels 3–4 mm long, sparsely puberulent. Perianth lobes

densely puberulent on both surfaces; perianth tube obconical, ca. 2.5 mm in diam., lobes 6, broadly ovate, ca. 2×1.7 mm, apex acute. Fertile stamens 9, ca. 1.6–1.8 mm long in 1st and 2nd whorls, 1.9 mm long in 3rd whorl; filaments nearly glabrous except near base, those of 3rd whorl with 2 sessile broadly ovate glands at middle; anthers oblong, those of 1st and 2nd whorls ca. 0.6 mm long, 4-celled, those of 3rd whorl ca. 0.3 mm long, 2-celled; Staminodes 3, ca. 1 mm long, short stalked. Ovary subglobose, ca. 1.9×1.6 mm; style ca. 1 mm long, stigma slightly 3-lobed. Fruit ovoid, ca. 1.1×0.6 cm, glabrous; perianth cup in fruit bowl shaped, 6–7 mm in diam., covering 1/3 of fruit; stalk somewhat thickened.

Distribution. Cambodia (endemic).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 1043 m, $10^{\circ}37'17''\text{N}$, $104^{\circ}01'52''\text{E}$, 10 December 2013, *Toyama et al.* 6302 (BKF, Cam, FU); alt. 1014 m, $10^{\circ}38'13''\text{N}$, $104^{\circ}02'06''\text{E}$, 4 December 2011, *Toyama et al.* 1444 (Cam, FU); 5 December 2011, *Toyama et al.* 1625 (Cam, FU); alt. 991 m, $10^{\circ}37'29''\text{N}$, $104^{\circ}04'27''\text{E}$, 22 December 2011, *Toyama et al.* 2548 [fr.] (Cam, FU); alt. 970 m, $10^{\circ}37'35''\text{N}$, $104^{\circ}03'57''\text{E}$, 23 October 2012, *Yahara et al.* 4437 (Cam, FU); alt. 941 m, $10^{\circ}39'05''\text{N}$, $104^{\circ}03'39''\text{E}$, 22 December 2011, *Toyama et al.* 2533 (Cam, FU); alt. 917 m, $10^{\circ}39'31''\text{N}$, $104^{\circ}03'05''\text{E}$, 25 October 2011, *Toyama et al.* 4582 (Cam, FU); alt. 167 m, $10^{\circ}36'10''\text{N}$, $103^{\circ}58'58''\text{E}$, 7 December 2013, *Tagane et al.* 6026 (BKF, Cam, FU); Kamchay et Montagne de l'Elephant, 15–17 December 1917, *Chevalier* 35991, 35993, 35994 (P); Bokor montagne de l'Elephant, 2 December 1933, *Poillane* 23021, 23023 (P); Kompong Smach, 22 November 1933, *Poillane* 22894 (P); alt. 981 m, 26 March, 2006, *Long et al.* 116 (P). —Phnom Penh: Foret de Phnom Penh, 10 July 1933, *service forestier* 618 (P).

GenBank accession No.: *Toyama et al.* 1444, AB936004 (*rbcl*), AB936005 (*matK*); *Toyama et al.* 1625, AB936016 (*rbcl*), AB936017 (*matK*); *Toyama et al.* 2548, AB936044 (*rbcl*), AB936045 (*matK*).

Note. The first specimen of *Cinnamomum dimorphandrum* was collected in 1917 by Chevalier (*Chevalier* 35991, P), on which Kostermans wrote, but never published, '*Cinnamomum myrtifolium*' in 1977.

***Lindera bokorensis* Tagane & Yahara, sp. nov.**
—Figs. 17, 18d–e.

Similar to *Lindera annamensis* H. Liu and *L. meisneri* Hook. f. f. *lenticellata* H. Liu, but distinct from the former in having more secondary veins (7–9 pairs in *L. bokorensis* vs. 4 or 5 in *L. annamensis*) and fewer flowers per umbel (2–4 vs. 10–13), and from the latter in pubescent branchlets without many white lenticels.

Types. CAMBODIA, Kampot: Bokor National Park, margin of dense evergreen forest on the table land, $10^{\circ}37'35''\text{N}$, $104^{\circ}03'57''\text{E}$, alt. 970 m, 23 Dec. 2012, *Yahara T*, *Tagane S*, *Fuse K*, *Naiki A*, *Yamaoto T*, *Zhu M*, *Chhang P*, *Choeung HN* 4427 (holotype—KYO; isotypes—Cam, FU, K).

Tree, dioecious, 6 m tall. Branchlets blackish, terete or slightly angular when young, yellowish brown pubescent, soon glabrescent, lenticellate; lenticels sparse, elliptic, brown. Leaves alternate, petioles 0.7–1 cm long, yellowish brown pubescent, leaf blade elliptic to narrowly elliptic, $4.5\text{--}7.7 \times 1.5\text{--}2.4$ cm, subcoriaceous, base cuneate, margin entire, apex acute or acuminate, pubescent when young, later glabrous, slightly lustrous on upper surface. Midvein not prominent adaxially, prominent abaxially, secondary veins pinnate, 7–9 pairs, prominent abaxially, tertiary veins obscure or faintly prominent and visible abaxially. Inflorescences umbels, corymbosely clustered on reduced branchlets in axils of leaves. Staminate umbels: peduncle 7–8 mm long, 8–12-flowered; involucre bracts 4, ca. 3.5 mm long, pubescent outside, glabrous inside except near apex, with many glands. Staminate flowers (examined in bud before anthesis): pedicel ca. 7 mm long, pubescent; tepals 6, nearly equal, ovate, ca. $1.1\text{--}1.3 \times 0.9\text{--}1$ mm, membranous, yellowish brown pubescent on both surfaces, glandular-punctate, apex obtuse; fertile stamens 9, filaments 0.3 mm long, pubescent; glands 2, reniform, at base of 3rd whorl of stamens; pistil reduced, ca. 0.6 mm long, glabrous. Carpellate flowers and fruit not seen.

Distribution. Cambodia (endemic to Mt. Bokor).

GenBank accession No.: *Yahara et al.* 4427, AB936053 (*rbcl*), AB936054 (*matK*).

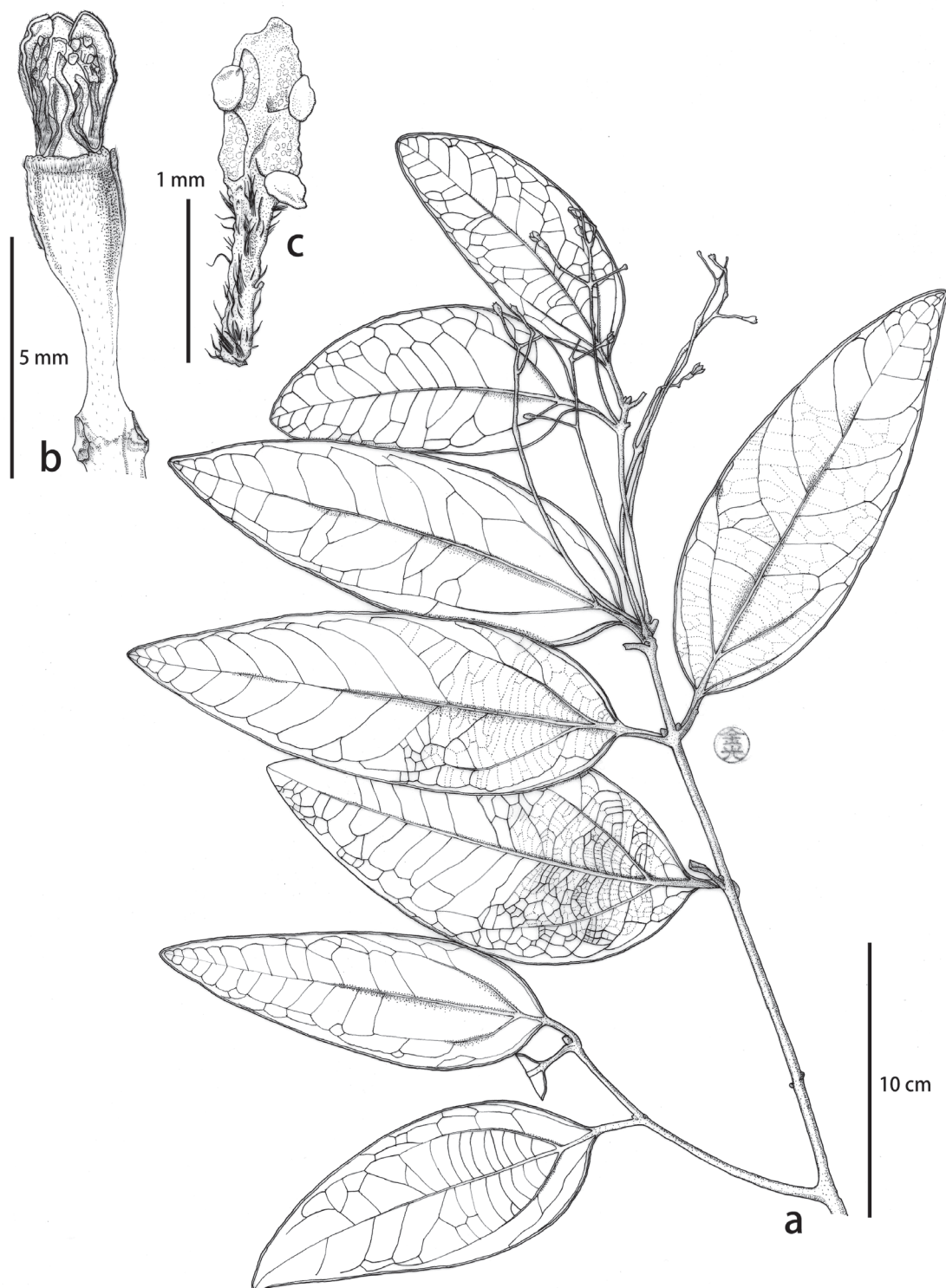


FIG. 14. *Cinnamomum bokorense* Tagane & Yahara. a, flowering branch; b, flower with petal removed; c, stamen from first whorl. a–c, Tagane *et al.* 3941, KYO. Drawn by H. Kanemitsu.



FIG. 15. *Cinnamomum bokorense* Tagane & Yahara. a, flowering branch; b, lower surface of leaf; c, inflorescence; d, flowers.

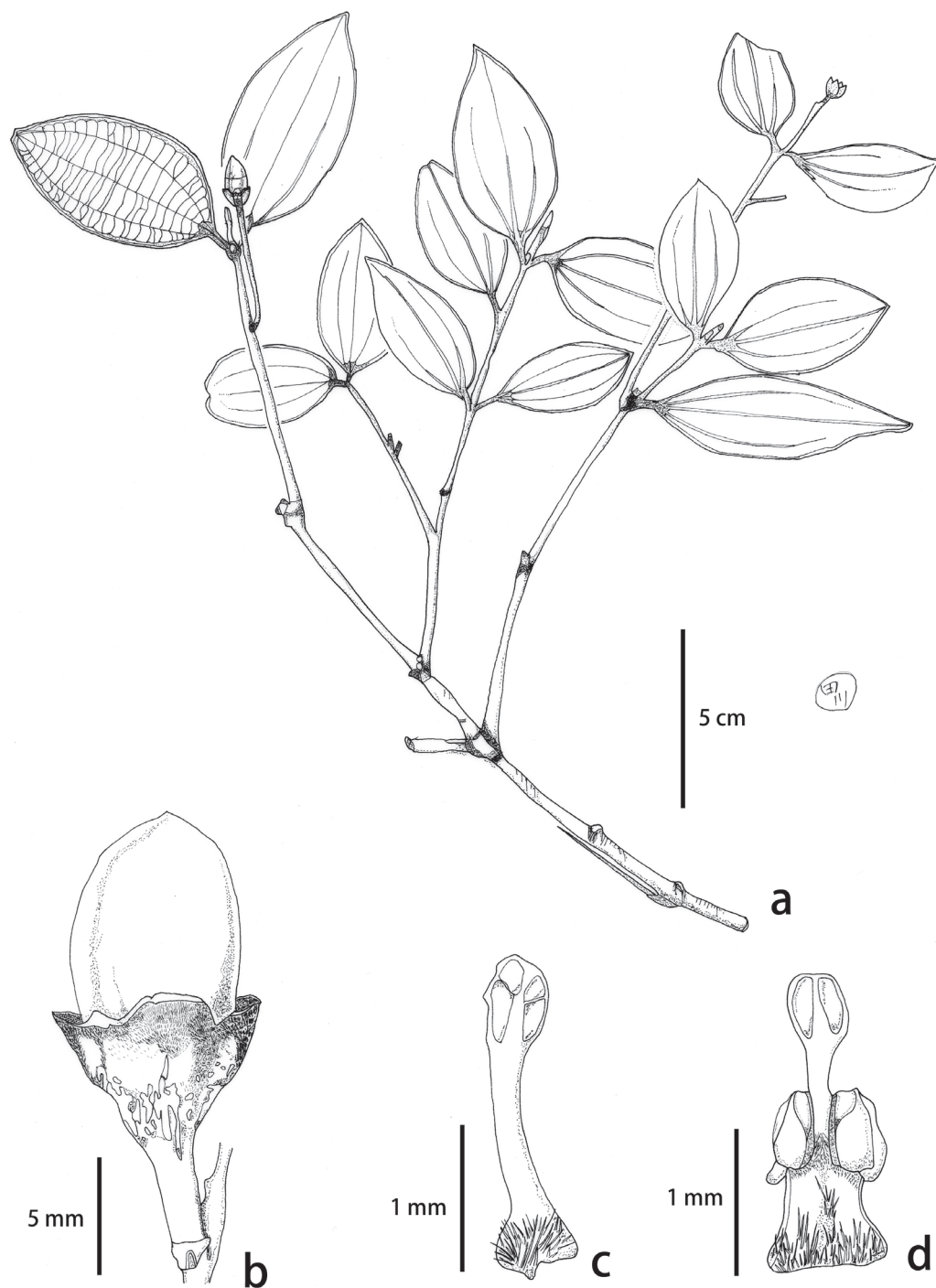


FIG. 16. *Cinnamomum dimorphandrum* Yahara & Tagane. a, habit; b, fruiting branch; c, stamen from first whorl; d, stamen from third whorl. a–d, Fuse *et al.* 6229, KYO. Drawn by K. Tagawa.

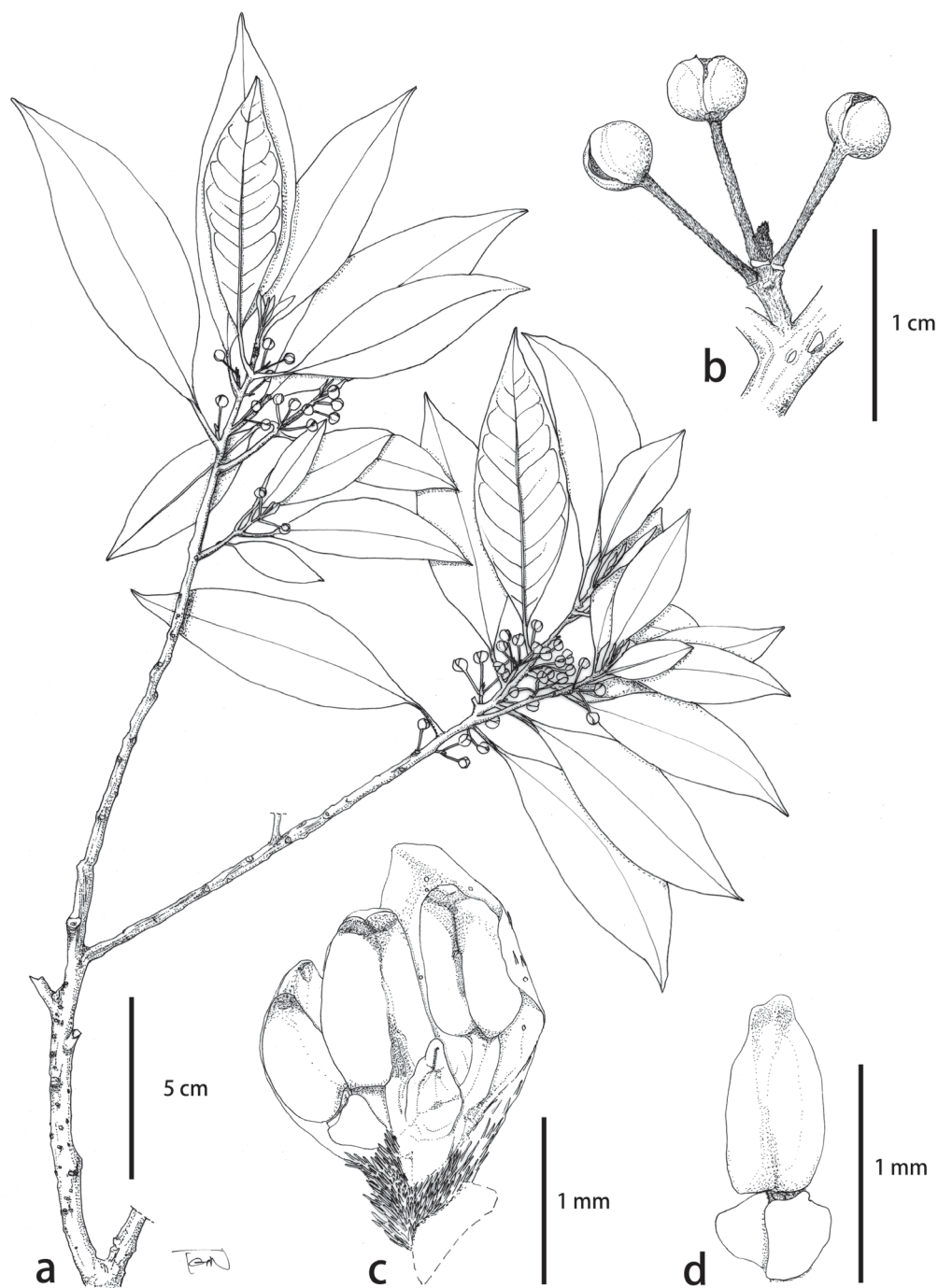


FIG. 17. *Lindera bokorensis* Tagane & Yahara. a, branch with flower bud; b, inflorescence; c, portion of flower; d, stamen from third whorl. a–d, Yahara *et al.* 4427, KYO. Drawn by S. Tagane.

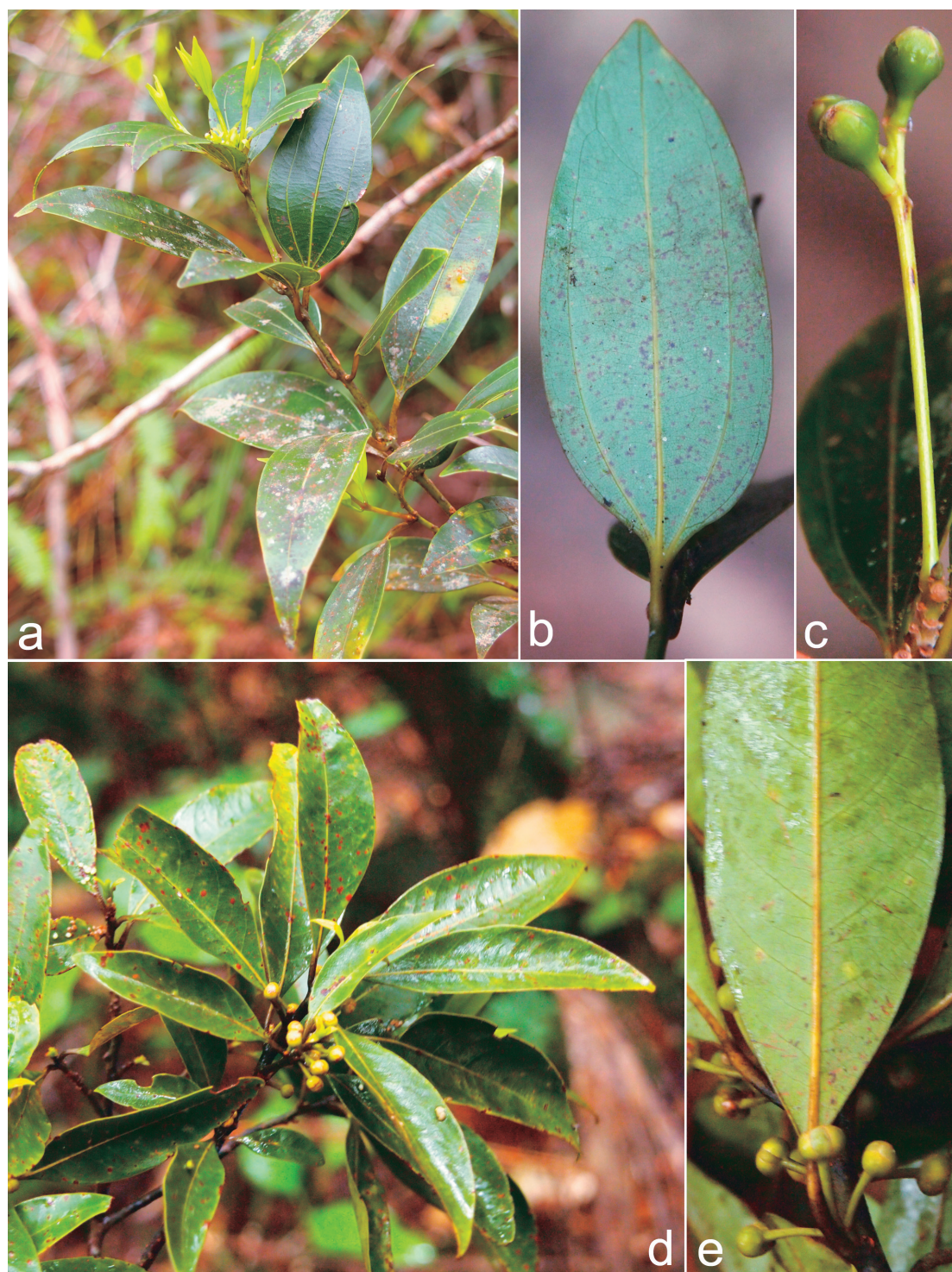


FIG. 18. *Cinnamomum dimorphandrum* Yahara & Tagane (a–c) and *Lindera bokorensis* Tagane & Yahara (e–f). a, habit; b, lower surface of leaf; c, inflorescence; d, branch with flower buds; e, lower surface of leaf.

Note. *Lindera bokorensis* is a tree around 6 m tall. We found it only once along the roadside of moist evergreen forest margin at 970 m. The above description is based on this collection with flower buds, thus the flower parts may be larger at anthesis.

Melastomataceae

***Memecylon bokorensis* Tagane, sp. nov.** —Figs. 19, 20

Similar to *Memecylon caeruleum* Jack, but differing in having slender and longer pedicels (7–8 mm long in *M. bokorensis* vs. 2–5 mm long in *M. caeruleum*), and ovate (rarely elliptic) leaves greenish or grayish when dry (oblong to elliptic, brownish to dark brown in *M. caeruleum*).

Types. CAMBODIA, Kampot: Bokor National Park, Popokvik waterfall, 10°39'35"N, 104°03'03"E, alt. 903 m, 18 July 2012, *Tagane S.*, *Fuse K.*, *Chhang P.* 4065 (holotype–KYO; isotypes–Cam, K).

Shrubs, 1.5–3 m tall; branchlets terete, glabrous, grayish or dark brown. Petiole (0.3–)0.5–0.7 mm long, glabrous. Leaf blade ovate, rarely elliptic, 9.8–14 × 3.8–5.8 cm, leathery, both surfaces glabrous, base broadly cuneate or obtuse, margin entire, apex acute. Secondary veins 5 or 6 pairs, faint or invisible when dry. Inflorescences axillary, umbel-like cymes, 1–1.6 cm long; peduncle 3–6 mm long, shallowly 4-angled; bracts triangular, ca. 0.8 mm long. Pedicels 4–6 mm long in immature fruit, 7–8 mm at fruit maturity, glabrous, ca. 0.7 mm thick. Hypanthium funnel shaped, 2.8–3.1 mm long, glabrous, outside pale blue, inside orange-red. Calyx lobes, petals, and stamens not seen. Fruit reddish, ellipsoid to obovoid, 1–1.3 × 0.7–0.8 cm, smooth, glabrous.

Distribution. Cambodia (endemic to Mt. Bokor).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 1014 m, 10°38'13"N, 104°02'06"E, 4 December 2011, *Toyama et al.* 1540 [fr.] (Cam, FU); alt. 903 m, 10°39'35"N, 104°03'03"E, 13 May 2012, *Toyama et al.* 3094 (Cam, FU); 18 July 2012, *Tagane et al.* 4060 [fl.] (Cam, FU); alt. 860 m, 10°39'34"N, 104°03'04"E, 11 December 2013, *Tagane et al.* 6337-bis [fr.] (BKF, Cam, FU); alt. 721 m, 10°37'40"N, 104°05'35"E, 12 December 2011,

Toyama et al. 2078 [fr.] (Cam, FU).

GenBank accession No. *Toyama et al.* 1540: AB936010 (*rbcL*), AB936011 (*matK*); *Toyama et al.* 2078: AB936035 (*rbcL*), AB936036 (*matK*).

Note. *Memecylon bokorensis* is a common shrub in the understory of moist evergreen forest at the upper elevations of Bokor National Park (above 700 m). A similar species, *Memecylon caeruleum* is at lower elevation in Bokor National Park. We did not observe the two species growing sympatrically.

Myrtaceae

***Syzygium elephantinum* Tagane, sp. nov.** —Figs. 21, 22

Similar to *Syzygium petelotii* Merr. & L. M. Perry in leaf characteristics but different in having axillary inflorescences, longer pedicels, and leaves with more secondary veins, 16–23 pairs. Also similar to *S. cerasiforme* (Blume) Merr. & L. M. Perry, but distinct in having smaller leaves with one intramarginal vein and smaller flowers with fewer gland dotted petals.

Types. CAMBODIA, Kampot: Bokor National Park, streambed along small stream in evergreen forest, 10°38'04"N, 104°05'19"E, alt. 741 m, 10 Dec. 2013, *Tagane S.* & *Chhang P.* 6210 (holotype–KYO; isotypes–BKF, Cam, FU).

Trees, 6 m tall. Bark brownish or grayish. Twigs 4-angled when young. Petiole 2.5–3 mm long. Leaf blade elliptic, elliptic-oblong or obovate, 3.8–8.9 × 1.5–4.3 cm, subcoriaceous, both surfaces glandular punctate, upper surface yellowish brown when dry, lower surface grayish green and not glossy when dry, base cuneate, margin entire, apex acute to acuminate; midrib impressed on upper surface, prominent on lower surface; secondary veins 16–23 pairs, (1–)2–3(–4) mm apart, arising at 60–70° from midvein, intramarginal vein 1, ca. 1 mm from margin. Inflorescences axillary and terminal, paniculate, 3–15-flowered; peduncle 0.5–1.4 cm long. Flowers: hypanthium funnel shaped, 3.5–4 mm long; pseudostipe 1–1.5 mm long; sepals 4, short triangular, ca. 0.1 mm long; petals 4, orbicular, 1.7–2 mm long, pseudo-calyptrate, membranous, with

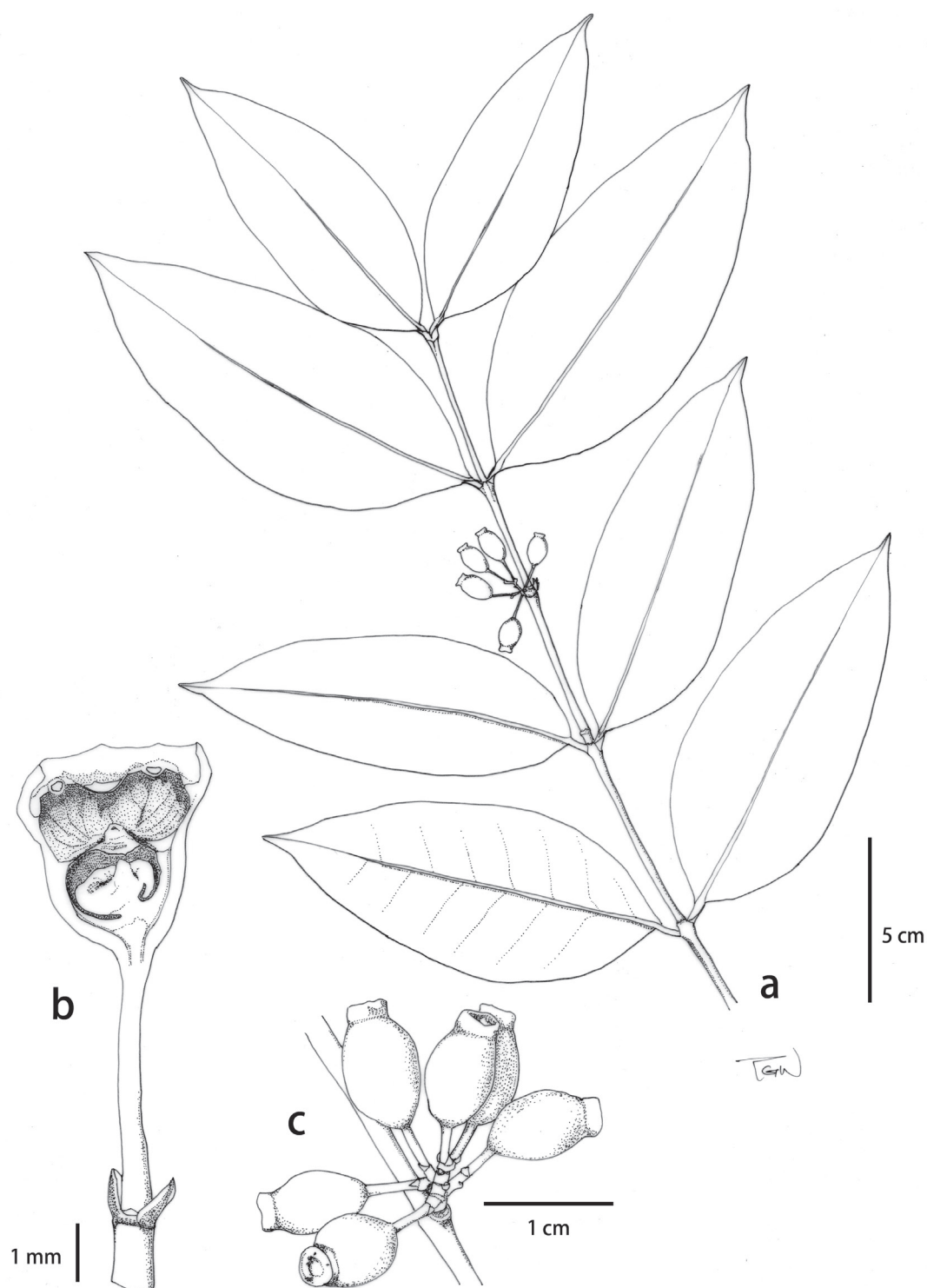


FIG. 19. *Memecylon bokorensis* Tagane. a, fruiting branch; b, flower dissection after petal dropped off; c, fruit. a-c, Tagane *et al.* 4065, KYO. Drawn by S. Tagane.

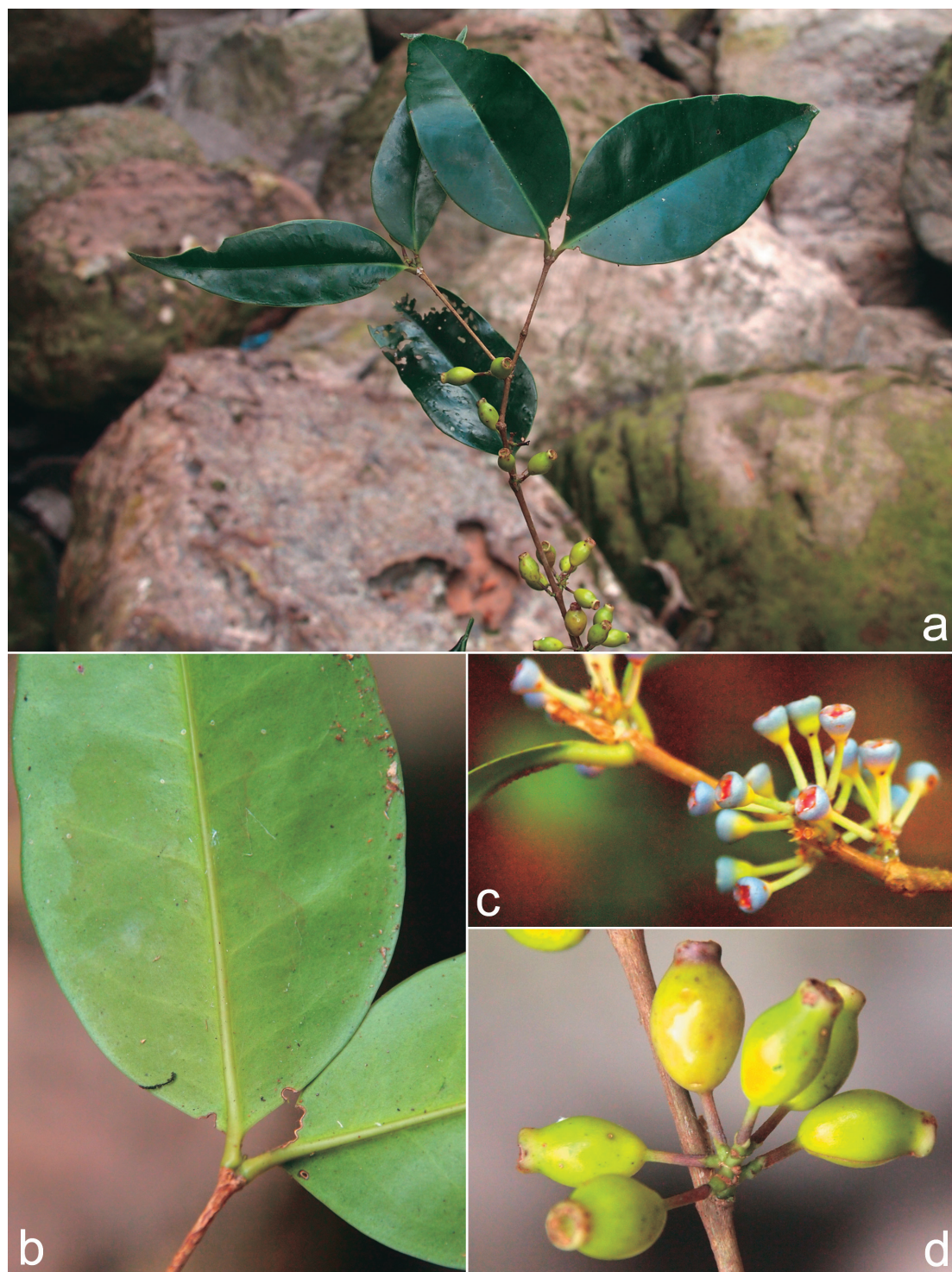


FIG. 20. *Memecylon bokorensis* Tagane. a, fruiting branch; b, portion of abaxial leaf surface; c, inflorescence after anthesis; d, infructescence.

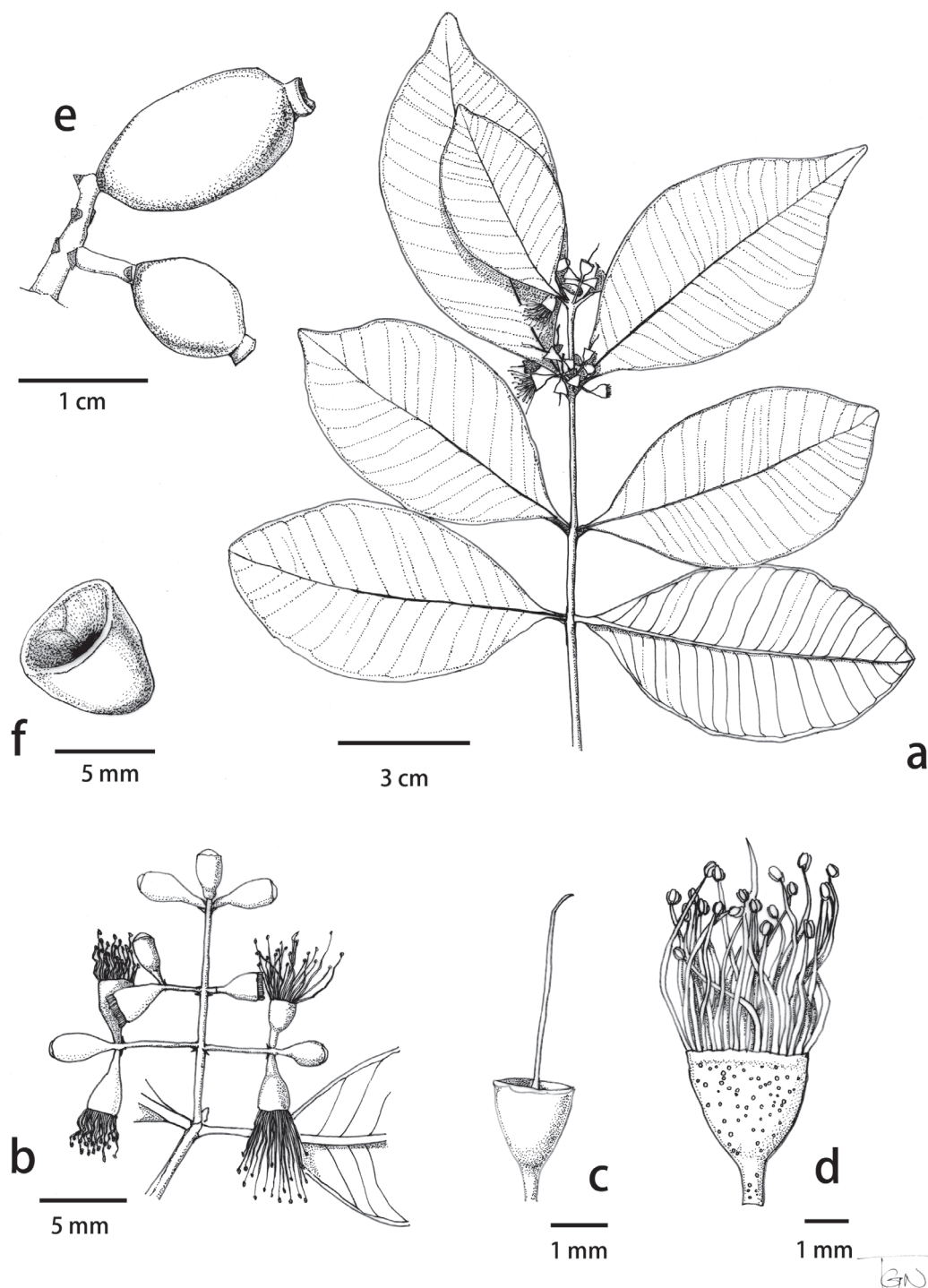


FIG. 21. *Syzygium elephantinum* Tagane. a, flowering branch; b, inflorescence; c, hypanthium cup with style; d, flower with petal removed; e, fruit; f, seed. a–d, Tagane *et al.* 4106, KYO; e–f, Tagane & Chhang 6210, KYO. Drawn by S. Tagane.



FIG. 22. *Syzygium elephantinum* Tagane. a, habit; b, flowering branch; c, lower surface of leaf; d, inflorescence; e, fruit.

14–17 gland dots per petal; stamens 3–6 mm long, anthers 0.25–0.3 mm long, filaments white; style 4–4.5 mm long. Fruit ellipsoid, 1.1–1.6 cm long, 0.6–0.8 cm in diam., smooth, with prominent apical calyx rim, ripening black. Seeds (1 or) 2, hemispherical, depressed ca. 1 mm at part facing second seed, 4–6 mm in diam., black.

Distribution. Cambodia (Bokor National Park).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 903 m, 10°39'35"N, 104°03'03"E, 13 May 2012, *Toyama et al.* 3144 (Cam, FU); alt. 741 m, 10°38'04"N, 104°05'19"E, 19 July 2012, *Tagane et al.* 4106 [fl.] (Cam, FU).

GenBank accession No. *Tagane et al.* 6210: AB936057 (*rbcL*), AB936058 (*matK*).

Note. *Syzygium elephantinum* is rare in moist evergreen forest near stream. The leaves are similar to those of *Syzygium petelotii* Merr. & L. M. Perry from northern Vietnam, and to *Syzygium cerasiforme* (Blume) Merr. & L. M. Perry from Malaysia, Indonesia (type specimen Java) and Thailand, but is distinguished as indicated in the diagnosis.

Phyllanthaceae

Phyllanthus bokorensis Tagane, **sp. nov.**—Figs. 23, 24

Similar to *Phyllanthus pulcher* Wall. ex Müll.Arg., but completely glabrous, even young shoots, thicker, shining leaves (membranous in *P. pulcher*) and staminate flowers with 6 sepals (sepals 4 in *P. pulcher*).

Types. CAMBODIA, Kampot: Bokor National Park, edge of evergreen forest along stream, 10°39'54"N, 104°02'49"E, alt. 860 m, 11 Dec. 2013, *Tagane S, Rueangruea S, Toyama H, Fuse K, Iwanaga F, Suddee S, Kanemitsu H, Zhang M, Kim W & Loth M* 6336 (holotype—KYO; isotypes—BKF, Cam, FU, K, P).

Shrubs, 1–2 m tall; branchlets sharply 4-angled, winged, glabrous. Stipules triangular or ovate, 2–2.8 × 1.7–2 mm. Petiole ca. 0.6 mm long. Leaf blade obovate, (0.7–)1–1.6 × (0.3–)0.4–0.7 cm, subcoriaceous, glabrous, lustrous on both surfaces, base cuneate, margin entire, revolute,

apex obtuse and apiculate; lateral veins 6–8 pairs, connected near margin, faintly prominent on both surfaces when dry, reticulation inconspicuous adaxially, slightly conspicuous beneath. Flowers axillary, solitary or in clusters of 2 or 3. Staminate flowers: pedicel ca. 3.3 mm long, glabrous; sepals 6, elliptic to obovate, 1.8–2 × 0.9 mm, disc glands 6, broadly obovate, ca. 0.3 mm long; stamens 3, staminal column ca. 0.5 mm long, anthers 1.1 × 0.6 mm. Pistillate flowers: pedicel 0.2–0.3 mm long, glabrous; sepals 6, broadly obovate, ca. 0.45 × 0.4 mm; disc urceolate, 0.8–1 mm long; ovary glabrous; style ca. 0.5 mm long; stigma ca. 0.8–1 mm long. Capsules ovoid, ca. 5 mm long, ca. 1 mm in diam.; pedicels 0.2–0.3 mm long. Seeds trigonous, ca. 3 × 2.5 mm.

Distribution. Cambodia (endemic to Mt. Bokor).

Other specimens examined. CAMBODIA, Bokor National Park, alt. 1014 m, 10°38'13"N, 104°02'06"E, 20 July 2012, *Tagane et al.* 4137 [fl. & fr.] (Cam, FU); alt. 917 m, 10°39'31"N, 104°03'05"E, 8 December 2011, *Toyama et al.* 1740 [fl. & fr.] (Cam, FU).

GenBank accession No.: *Toyama et al.* 1740, AB936022 (*rbcL*), AB936023 (*matK*).

Note. *Phyllanthus bokorensis* is common along the sides of rocky rivers, especially below Popokvil Waterfall, and is occasional in open rocky places on the plateau. The pistillate flowers are similar to those of *Phyllanthus albidiscus* (Ridl.) Airy Shaw in having an urceolate disc, which almost completely encloses the ovary. The following characters of *P. albidiscus* (Van Welzen & Chayamarit 2007) distinguish it from *P. bokorensis*: branchlets terete, leaves 3.3–9.5 × 1.4–3.4 cm, lateral veins 10–15 pairs, margin of pistillate sepals somewhat fimbriate.

Primulaceae

Ardisia smaragdina Yahara & Tagane, **sp. nov.**—Figs. 25, 26

Similar to *A. smaragdina* Pit., but differing in trees to 8 m

tall in *A. smaragdina* vs. shrub usually 1–1.5 m tall in *A. smaragdina*, thinner leaves (chartaceous vs. coriaceous) and spreading calyx lobes at anthesis (distinctly imbricate in *A. smaragdina*). Also similar to *A. fulva* King & Gamble, but distinguished by having glabrous leaves, cymes and calyx and longer flowers.

Types. CAMBODIA, Kampot: bottom of Mt. Bokor, secondary evergreen forest, 10°36' 10"N, 103°58'58"E, alt. 167 m, 7 Dec. 2013, Tagane S, Toyama H, Fuse K, Iwanaga F, Rueangruea S, Suddee S, Kanemitsu H, Zhang M, Kim W, Loth M 6028 (holotype—KYO; isotypes—BKF, Cam, FU, K).

Description. Trees 8 m tall. Branches terete, all parts glabrous. Petiole 0.5–1.1 mm long. Leaf blade chartaceous, lanceolate to elliptic-lanceolate, 4.5–10.8 × 1–2.5 cm, base cuneate, margin entire, apex acute or acuminate, both surfaces glabrous; glandular dots many, black, visible on both surfaces; secondary veins 14–18 pairs, curved-ascending, obscure. Inflorescences axillary, subumbellate, 2–4(–6)-flowered; peduncle slender, 1.5–3 cm long, glabrous; pedicels 1.4–2 cm long, glabrous. Flowers ca. 14 mm in diam.; calyx ca. 2.5 mm long, deeply 5-lobed; lobes ovate, ca. 2 mm wide, apex acute, not overlapping at base, dotted with dark glands, glabrous except distinctly ciliate margin, spreading from bud stage to fruiting. Corolla tube ca. 0.5 mm long, lobes broadly ovate, ca. 7 × 4.5 mm, apex acute, white or rarely reddish purple, with pale glandular dots and lines, never blackish. Anthers ca. 4.4 mm long, with a few blackish glandular dots. Ovary glabrous; style ca. 4.6 mm long, narrowed upwards. Drupes globose, ca. 0.7 cm in diam., frequently with persistent style.

Distribution. Cambodia (Mt. Bokor), Thailand (SE: Ko-Chang, Trat); probably endemic to Cardamome-Elephant mountains and surroundings.

Other specimens examined. CAMBODIA, Bokor National Park, alt. 314 m, 10°36'20"N, 104°05'02"E, 6 December 2011, Toyama et al. 1694 [fl. & fr.] (Cam, FU); alt. 166 m, 10°36'10"N, 103°58'58"E, 17 February 2013, Tagane et al. 5547 [fr.] (Cam, FU); alt. 16 m, 10°35'27"N, 103°58' 35"E, 7 December 2013, Tagane et al. 6009 [fl. & fr.] (BKF, Cam, FU). Thailand—Ko Chang Island, Trat Province: Khlong Phlu waterfall, alt., 100 m, 23 Mar. 2001, Chayamarit et al. 2811 (BKF); alt. c. 70 m, 5 Mar.

2003, Pengklai et al. 14144 & 14196 (BKF); Trail from Khlong Phlu Ranger Station, alt., 120 m., 6 Jan. 2009, Middleton et al. 4629 (BKF).

GenBank accession No. Toyama et al. 1694: AB936020 (*rbcL*), AB936021 (*matK*).

Note. In Bokor National Park, *Ardisia smaragdina* is occasional in evergreen forest stands from low to mid elevations (16–400 m). It is particularly common with *Syzygium formosum* (Wall.) Masam., *Croton phuquocensis* Croizat and *Calophyllum pisiferum* Planch. & Triana in open places along rapidly flowing streams. The similar *Ardisia smaragdina* occurs only in dense evergreen forests on the plateau at 800–1,000 m. The two, altitudinally isolated species therefore do not occur sympatrically, although there was no differences in the *rbcL* and *matK* sequences between them [GenBank accession no. of *A. smaragdina*: Toyama et al. 1583, AB936012 (*rbcL*), AB936013 (*matK*); Toyama et al. 1609, AB936014 (*rbcL*), AB936015 (*matK*)]. *Ardisia smaragdina* is also similar to *A. fulva*, which is endemic to peninsular Thailand, but the midvein of the leaves, cymes and calyx of *A. fulva* are pubescent, and *A. fulva* has slightly smaller flowers. A specimen collected in Gunung Rapat, Perak, Malaysia (Joanne Tan P.C. FRI77623, 29 Mar. 2012, KEP, K, SAN, SING, BKF), is also similar to *A. smaragdina*, but distinct in having more secondary veins (at least 20 pairs). *Ardisia smaragdina*, *A. smaragdina*, *A. fulva* and an apparently undescribed taxon from Malaysian FRI77623 are probably closely related.

Almost all the individuals of *Ardisia smaragdina* in Bokor National Park had white petals; reddish purple petals are rare. Middleton et al. 4629 (BKF) from Thailand, is recorded to have reddish purple petals.

Rosaceae

***Rhaphiolepis mekongensis* (Cardot) Tagane & H. Toyama, stat. nov.**—Figs. 27, 28

Rhaphiolepis indica (L.) Lindl. var. *mekongensis* Cardot in Notul. Syst. (Lecomte) 3: 380 (1918); in

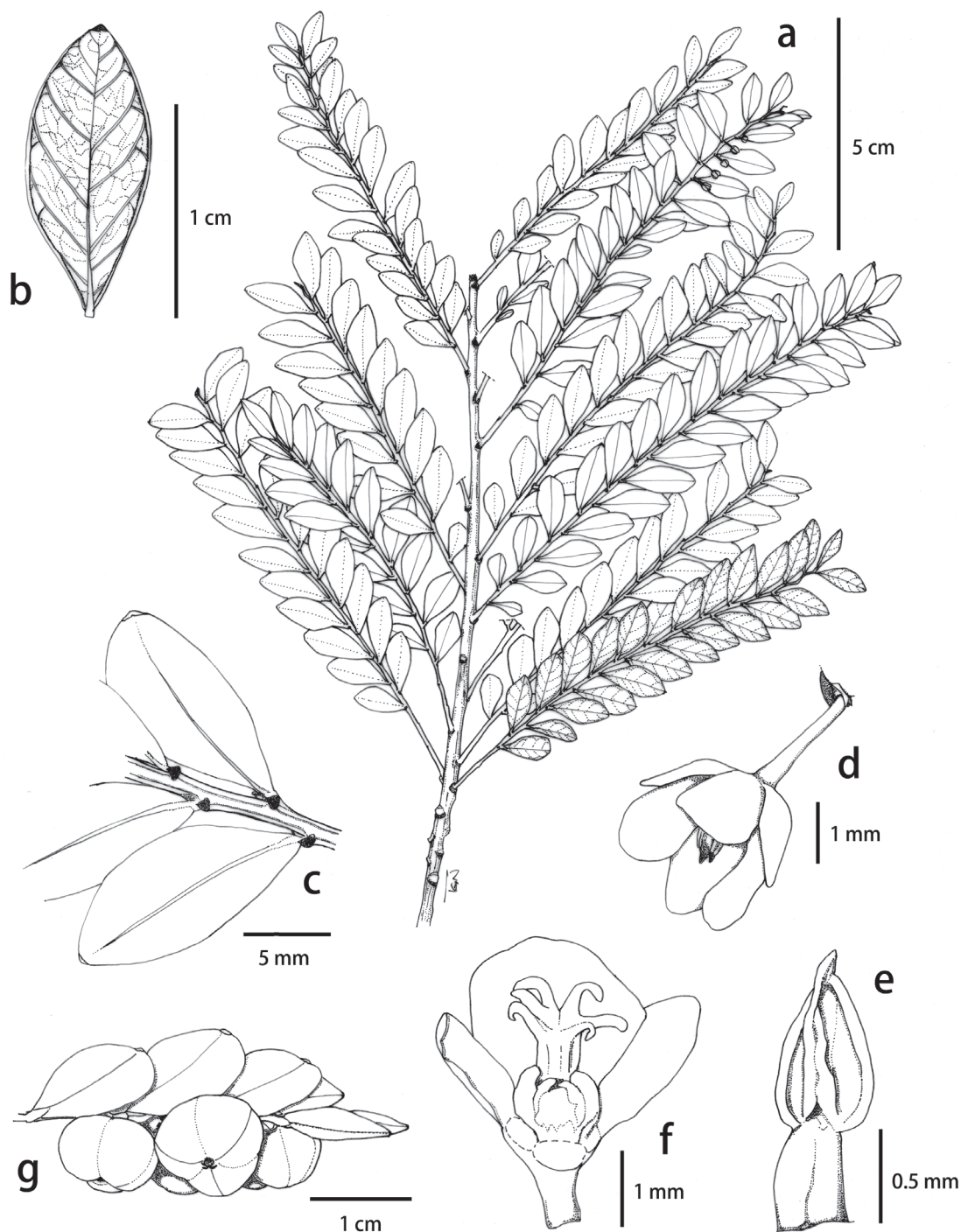


FIG. 23. *Phyllanthus bokorensis* Tagane. a, flowering branch; b, lower surface of leaf; c, portion of adaxial branch; d, staminate flower; e, stamen; f, pistillate flower; g, portion of fruiting branch. a-g, Tagane *et al.*, 6336, KYO. Drawn by S. Tagane.

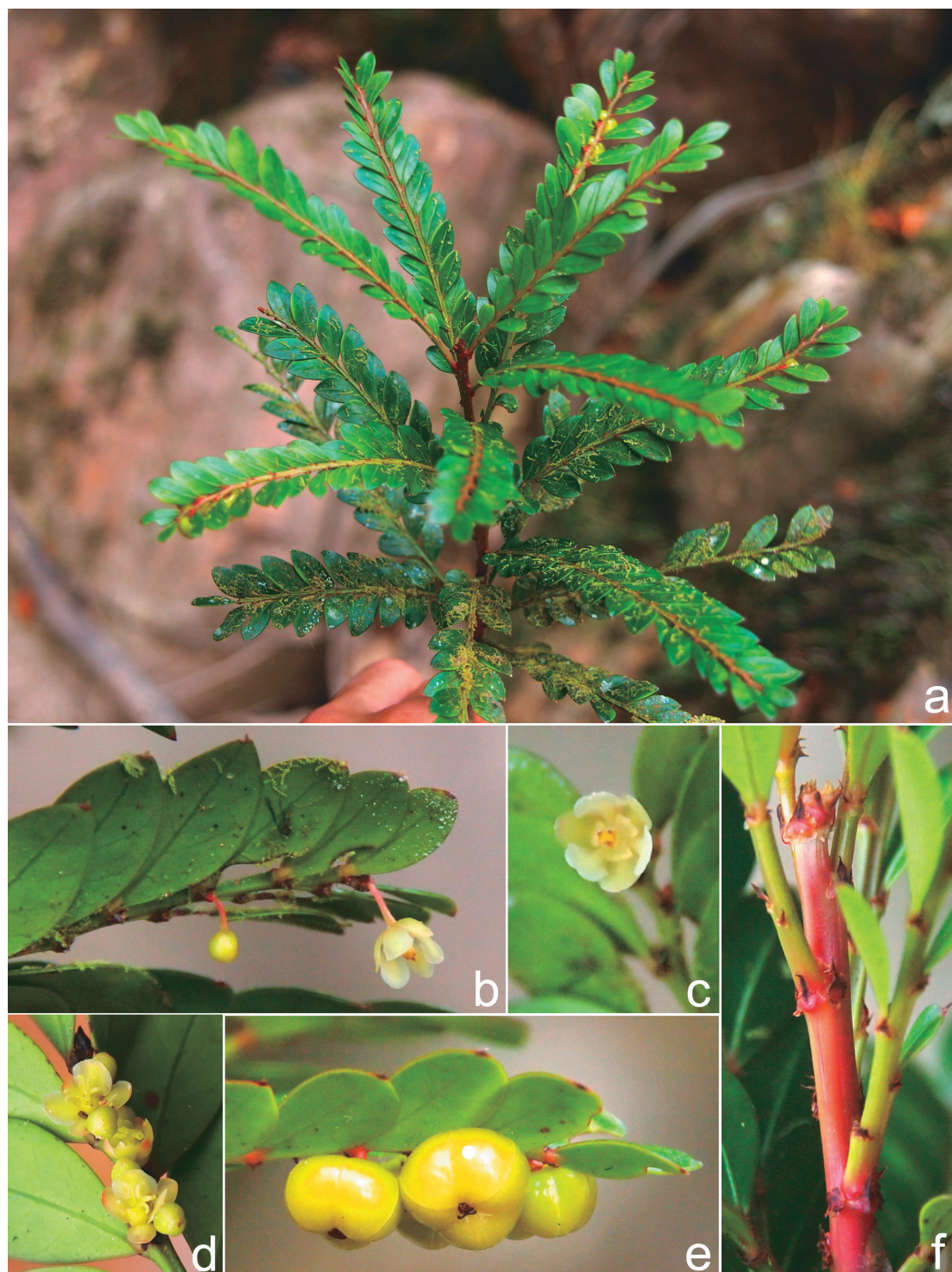


FIG. 24. *Phyllanthus bokorensis* Tagane. a, habit; b–c, staminate flower; d, pistillate flower; e, fruiting branch; f, top branch.

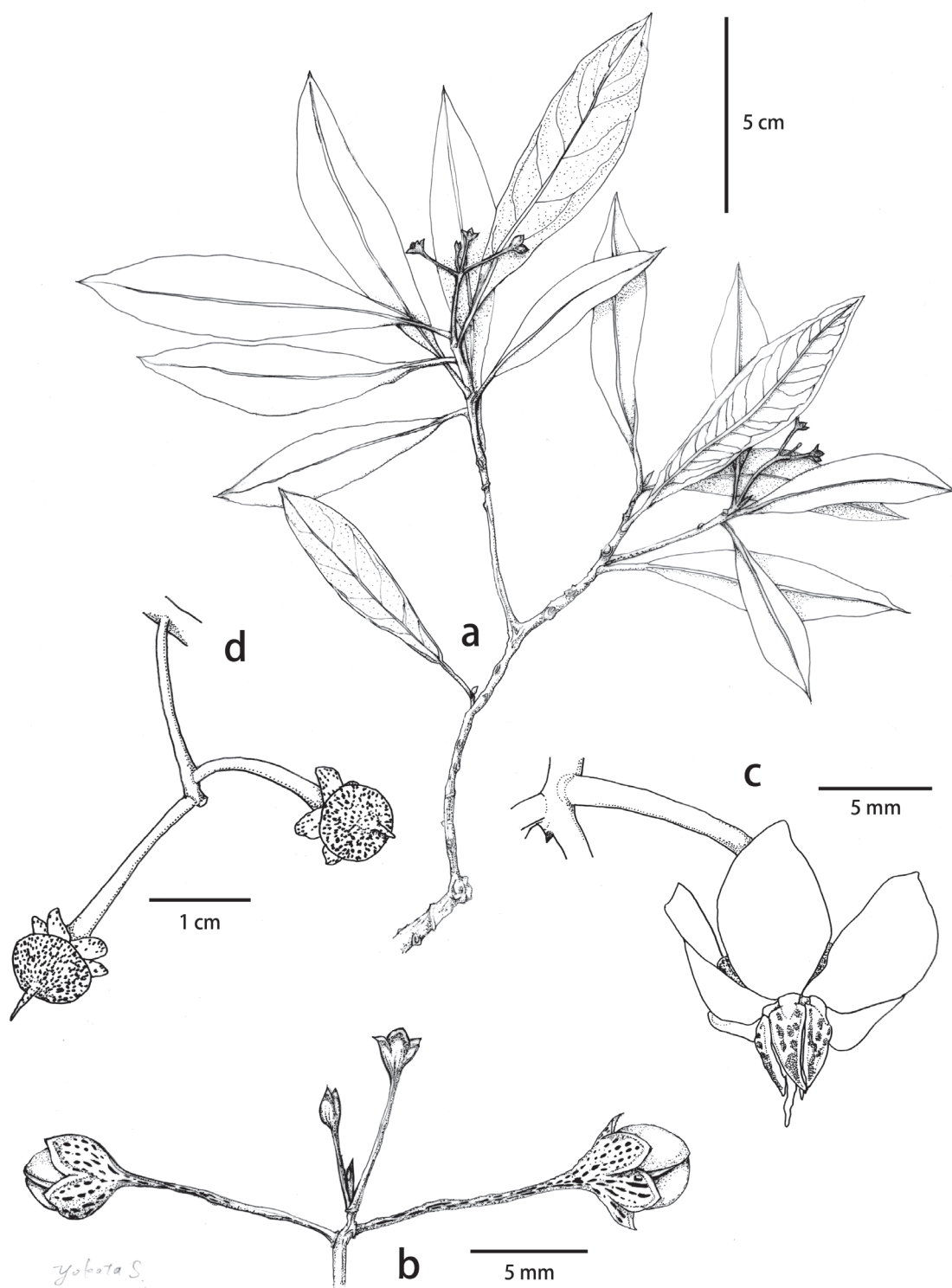


FIG. 25. *Ardisia smaragdinoides* Yahara & Tagane. a, branch with inflorescence; b, portion of inflorescence; c, flower; d, fruit. a–b, Toyama *et al* 1694, KYO. Drawn by S. Yokota; c–d, Tagane *et al*. 6028, KYO. Drawn by S. Tagane.

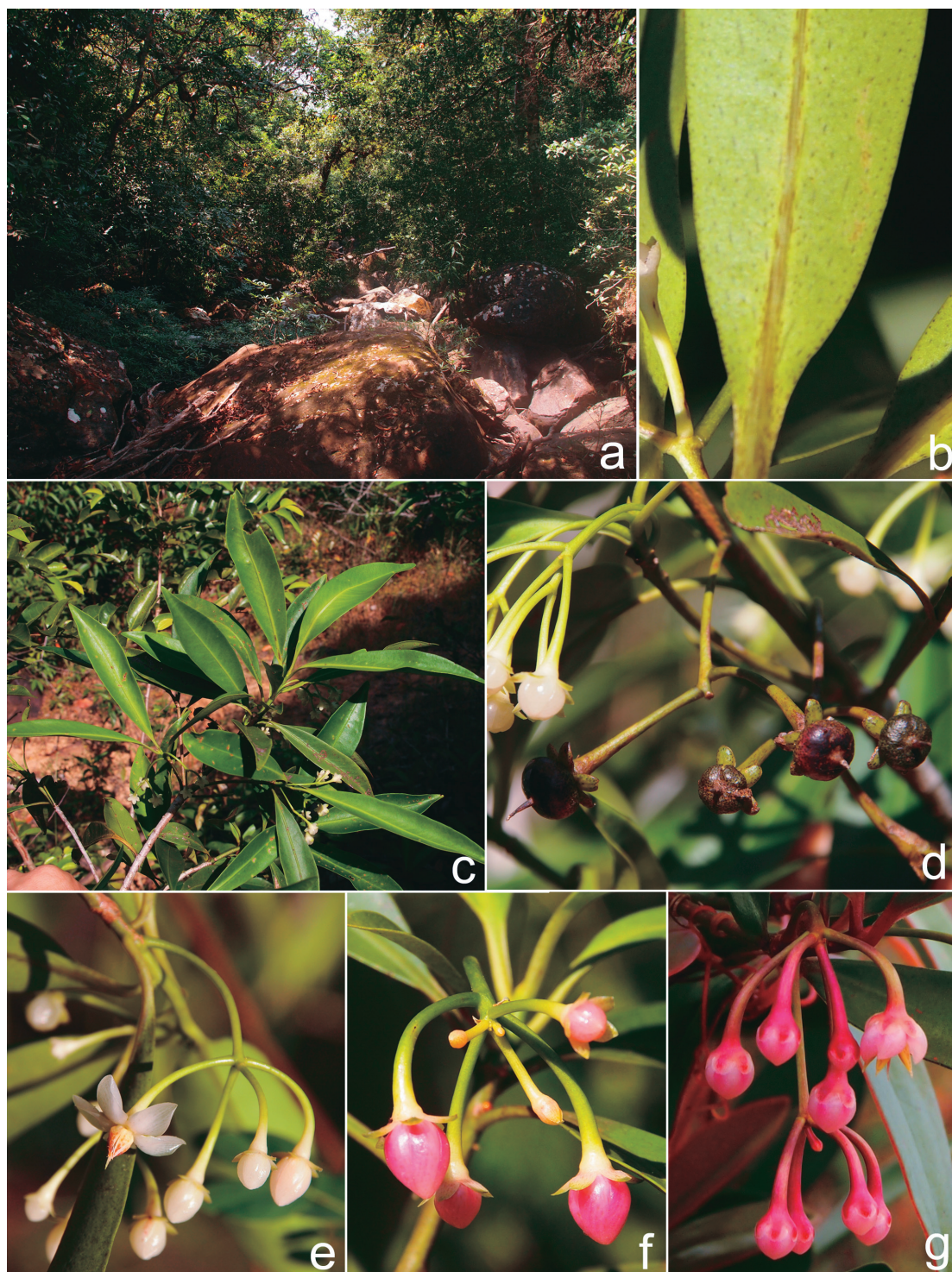


FIG. 26. *Ardisia smaragdina* Yahara & Tagane (a–f) and *Ardisia smaragdina* Pit. (g). a, habitat; b, lower surface of leaf; c, flowering branch; d, fruit; e, inflorescence with white flower; f, inflorescence with pink flower; g, inflorescence.

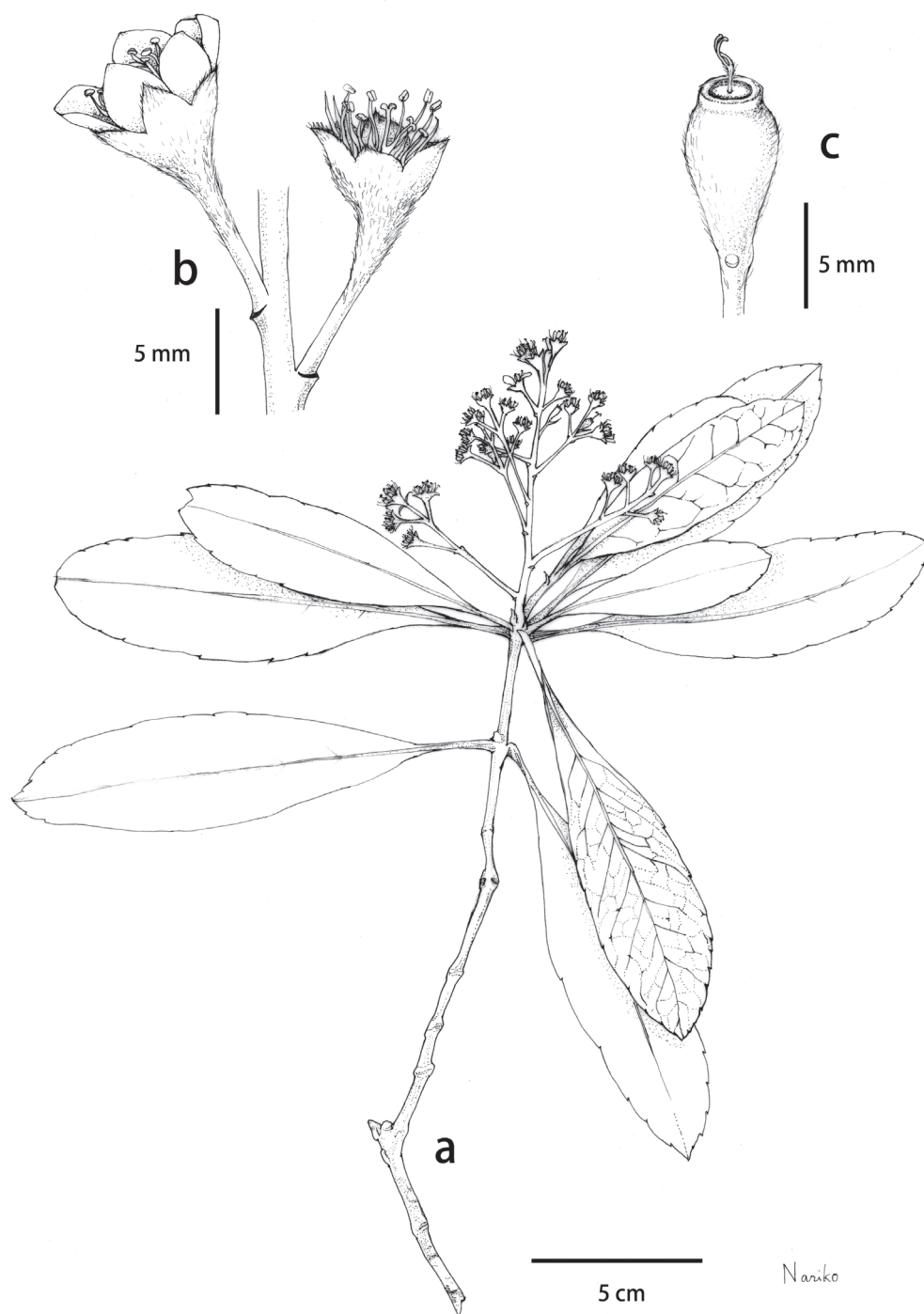


FIG. 27. *Rhaphiolepis mekongensis* (Cardot) Tagane & H. Toyama. a, Flowering branch; b, flowers; c, ovary with stigma. a–c, Tagane et al. 5483, KYO. Drawn by N. Toyama.



FIG. 28. *Rhaphiolepis mekongensis* (Cardot) Tagane & H. Toyama (a–c) and *Rhaphiolepis indica* (L.) Lindl (d). a, Flowering branch; b, flowers; c and d, lower surface of leaf.

Lecomte *et al.*, Fl. Gén. Indo-Chine 2: 680 (1920).

Rhaphiolepis mekongensis has thicker and larger leaves, 7.5–12.3 × 2.1–4 cm with more coarsely reticulate tertiary veins, whereas *R. indica* (L.) Lindl. has thinner and smaller leaves, 5.4–8.5 × 1.7–3.2 cm with conspicuous, finely reticulate veins.

Types. CAMBODIA, Kampot: Mt. Kamchay alt. ca 800 m, 14 Jan. 1904, *Geoffray 340* (lectotype–P, designated here); monts Kamchay, Kampot, 1874, *Pierre s.n.* (syntypes–P); Laos, Bassin du Mékong, rivière Selamphao, 1876, *Harmond 202* (syntypes–P).

Trees, to 12 m tall. Branchlets purplish brown when young, grayish brown when old, terete, initially brown tomentose, soon glabrous. Stipules caducous, lanceolate ca. 6 × 1.2 mm, apex acuminate, almost glabrous. Petiole 1.2–1.6 cm long, glabrous. Leaf blade oblanceolate to elliptic, (6.3–)7.5–12.3 × (1.5–)2.1–3.5(–4) cm, leathery, glabrous, upper surface lustrous, base attenuate, margin shallowly crenate with 12–17 teeth on each side, apex obtuse or acute, midvein prominent on lower surface, lateral veins 9–12 pairs, faintly prominent on lower surface, tertiary veins reticulate, 2–3 mm from each other, slightly conspicuous on lower surface. Inflorescences terminal panicles, with 5–8 secondary axes, peduncle glabrescent; bracts narrowly lanceolate, 3–5.5 mm long, glabrescent. Pedicels 2–5 mm long, rusty tomentose, soon glabrescent. Flowers 1–1.5 cm in diam. Hypanthium funnel shaped to narrowly campanulate, rusty tomentose. Sepals 5, triangular, ca. 2 mm long, rusty tomentose on both surfaces, apex acute. Petals 5, white, broadly obovate to orbicular, 4.5–5 × 4 mm, apex acute to obtuse, glabrescent on both surfaces. Stamens 20–24, ca. 3–5 mm long, glabrous, anthers ca. 1.2 mm long. Ovary 2-loculed; ovules 2 per locule. Styles 2, connate from base to middle, ca. 5 mm long, pubescent. Pomes not seen. [according to Cardot (1920), “larger fruit, ovoid or oblong, 6–8 mm long, about 4–5 mm wide].

Distribution. Cambodia and Laos.

Other specimens examined. CAMBODIA, Bokor National Park, alt. 1014 m, 10°38'13"N, 104°02'06"E, 4 Dec. 2011, *Toyama et al. 1470* (Cam, FU); 5 Dec. 2011, *Toyama et al. 1636* [f] (Cam, FU); alt. 933 m, 10°39'20"N, 104°03'37"E, 16 Feb. 2013, *Tagane et al. 5483* [f]

(Cam, FU); ca. 3000 ft, 20 Feb. 1960, *Abbe E.C. et al. 9655* (BKF); Mont de l'elephant, 10 Aug. 1919, *Poilane 284* (P); Mt. Camchay, Jan. 1874, *Harmond 202* (P); Bokor Montague de l'Elephant, 1 December, 1933, *Poilane 22994 bis* (P).

GenBank accession No. *Toyama et al. 1470*: AB936006 (*rbcL*), AB936007 (*matK*); *Toyama et al. 1636*: AB936018 (*rbcL*), AB936019 (*matK*).

Note. *Rhaphiolepis mekongensis* is occasional in moist evergreen forest on the plateau. It was first described as *Rhaphiolepis indica* var. *mekongensis* by Cardot in 1918 based on the three specimens cited above. Although Cardot (1920) suspected that it may be a distinct species, Vidal (1968) considered it to be a variety *R. indica*. Here, we distinguish *R. mekongensis* from *R. indica* at the species level. The two species co-occur on the plateau of Mt. Bokor where they are easily distinguished by the characteristics mentioned above. *Rhaphiolepis mekongensis* tends to have more stamens, but the number of stamens is highly variable and not useful for distinguishing the two species. The *matK* sequences differ at 2 of 864 bases between *R. mekongensis* and *R. indica* [*GenBank accession No. Toyama et al. 2450*: AB936041 (*matK*); DQ860474, JQ391063, JQ391064], supporting our treatment. The detailed description of *R. mekongensis* above is based on our collections, since previous descriptions of *R. mekongensis* are shorter and lack a description of the flowers.

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